TRANSACTIONS and PROCEEDINGS

OF THE

BOTANICAL SOCIETY OF EDINBURGH

VOLUME XXXVII
Part II
SESSION 1955-56

PRINTED FOR THE BOTANICAL SOCIETY BY
T. BUNCLE & CO. LTD., ARBROATH
And to be obtained from the SECRETARY OF THE SOCIETY, *at the Royal Botanic Garden*
1957

rice to Non-Members—15/-

PROCEEDINGS
OF THE
BOTANICAL SOCIETY OF EDINBURGH

SESSION CXX

OCTOBER 20, 1955.

Dr. J. A. MACDONALD, President, in the Chair.

Dr. JOHN RAMSBOTTOM, O.B.E., delivered the Second Wright Smith Lecture. His subject was "The Agaric, Amadou and the Fungus-Stone".

NOVEMBER 10, 1955.

Dr. J. A. MACDONALD, President, in the Chair.

Miss J. BUCHANAN, Mr. J. MCNEILL and Mr. D. W. R. MACKENZIE were elected Ordinary Fellows.

Dr. M. E. D. POORE read a paper entitled "Aerial Photography in a Vegetational Survey of Jordan".

DECEMBER 15, 1955.

Dr. J. A. MACDONALD, President, in the Chair.

Professor J. H. BURNETT, Dr. D. C. GRAHAM, Mr. T. MOSES and Dr. W. L. POEL were elected Ordinary Fellows and Miss M. BRUCE, Mr. R. BARKER and Mr. R. B. KNOX were elected Ordinary Members.

The following papers were read by title:

"Flowering Plants and Ferns of the Isle of May". By W. J. EGGELING.

"Notes on British Species of the Genus *Sphacelaria* Lyngb." By D. E. G. IRVINE.

"Further Additions to the Algal Flora of St. Andrews, Fife". By H. BLACKLER.

"The Phenology of Certain Algae at St. Andrews, Fife". By H. Blackler.

Dr. J. G. Hawkes then delivered a paper entitled "Potato Hunting in the Andes".

JANUARY 19, 1956.

Dr. J. A. Macdonald, President, in the Chair.

Professor A. R. Gemmell, Dr. E. Cutter, Dr. D. E. G. Irvine, Mr. R. Boggie, Dr. D. W. Burns, Dr. F. Cusick, Mr. R. E. C. Ferreira, Mrs. A. H. Somerville and Dr. J. Stirling were elected Ordinary Fellows and Miss A. D. Heggie and Mr. J. S. Tweedie were elected Ordinary Members.

Films were shown on:

"Seed Dispersal by Exploding Fruits".
"The Fern".
"Myxomycetes".

A Soirée with botanical Exhibits was then held.

FEBRUARY 16, 1956.

Dr. J. A. Macdonald, President, in the Chair.

Dr. W. J. Eggeling delivered a paper entitled "The Isle of May: its History and Natural History".

Members of the Edinburgh Natural History Society were guests of the Botanical Society for this meeting.

MARCH 8, 1956.

Dr. J. A. Macdonald, President, in the Chair.

Miss J. M. Allford, Miss E. M. Birse, Mr. W. T. Cowan, Mr. S. E. Durno, Dr. W. W. Fletcher, Mr. J. D. Forrest, Dr. A. G. Lyon and Dr. R. A. Robertson were elected Ordinary Fellows.

Professor H. D. Gordon delivered a paper entitled "The Vegetation of Tasmania".

APRIL 19, 1956.

Dr. J. A. Macdonald, President, in the Chair.

Mr. C. D. K. Cook and Mr. W. S. Gavin were elected Ordinary Fellows and Mr. J. Horsman was elected an Ordinary Member.

In a symposium on "Recent Work on the Scottish Flora" the following papers were read:

"New Algal Records". By H. Blackler.

"Studies in the British Species of *Sparganium*". By C. D. K. Cook.

"Variation in *Solidago virgaurea*". By J. McNeill.

MAY 17, 1956.

Dr. J. A. Macdonald, President, in the Chair.

Mrs. R. R. Clarke was elected an Ordinary Member.

Mr. W. T. Cowan read a paper entitled "Modern Methods of Combating Plant Diseases".

JUNE 14, 1956.

ANNUAL GENERAL MEETING.

Dr. J. A. Macdonald, President, in the Chair.

The following Office-Bearers were elected for Session 1956-57:

PRESIDENT

J. A. Macdonald, Ph.D., D.Sc., F.R.S.E.

VICE-PRESIDENTS

J. G. Roger, B.Sc., F.L.S.
D. M. Henderson, B.Sc.
D. H. N. Spence, B.Sc.
H. R. Fletcher, D.Sc., F.R.S.E.

COUNCILLORS

E. E. Kemp, N.D.H., D.Inst. P.A.
Miss E. Beattie.
Miss C. W. Muirhead.
J. Smith, D.Sc.
Miss M. M. Macdonald, B.Sc.
Miss P. J. Watson, Ph.D.
A. Nelson, D.Sc., F.R.S.E.
C. E. Foister, Ph.D.
Miss L. I. Milne.

Honorary Secretary—P. S. Green, B.Sc., F.L.S.
Assistant Secretary—Miss D. E. Purves.
Cryptogamic Secretary—D. M. Henderson, B.Sc.
Editor—Miss A. M. MacLeod, Ph.D. (Heriot-Watt College, Edinburgh).
Treasurer—R. T. Hunter, C.A.
Artist—R. Eudall.
Auditor—C. A. Scott, C.A.

The Treasurer, Mr. R. T. Hunter, submitted the following Statement of Accounts for the Session 1955-1956:

INCOME.

Annual Subscriptions		£106 0 0
Arrears of Subscriptions recovered		15 0 0
Transactions sold		40 9 8
Interest on Investments		25 0 9
Subscriptions to Publications Fund		6 0 0
Income from Botanical Society Trust Fund		12 7 6
Income Tax recoverable 1955-56		16 1 10
Grants—		
Carnegie Trust	£100 0 0	
Russell Trust	50 0 0	
		150 0 0
Transferred from Capital Fund		43 0 0
Excess of Expenditure over Income		—
		£413 19 9

EXPENDITURE.

Printing *Transactions*, Vol. 37 (Part I)	£257 10 6
Printing, Postages of Notices, etc.	73 10 1
	£331 0 7
Less—Over-estimated, 1954-55	42 16 3
	£288 4 4
Stationery, Postages, etc.	14 0 7
Fire Insurance on Books	0 5 0
Projector and Film	3 3 0
Bank Charges	0 17 6
Lecture Expenses—Dr. Hawkes	5 12 11
Honorarium to Treasurer	5 5 0
Honorarium to Assistant Secretary	5 0 0
Excess of Income over Expenditure	91 11 5
	£413 19 9

BALANCE SHEET AS AT 30TH APRIL 1956.

LIABILITIES.

I.	Capital Funds—		
	Balance brought forward from 1954-55		£846 4 2
	Add—Life Compositions received in 1955-56	£14 0 0	
	Donations	4 6 0	
			18 6 0
			£864 10 2
	Transferred to Revenue 5% of £864		43 0 0
			£821 10 2
	Add—Excess of Income over Expenditure 1955-56 ...		91 11 5
			£913 1 7
II.	Subscriptions received in advance—		
	1956-57. Mrs. Elmy	£0 5 0	
	L. A. Lauener	1 0 0	
	Prof. Braid	1 0 0	
	Dr. Corrie	1 0 0	
	W. L. Coutts	1 0 0	
	1957-58. Mrs. Elmy	0 5 0	
			4 10 0
III.	Printer's Account Outstanding—		
	Printing *Transactions*	£257 10 6	
	Notices of Meetings and Postages ...	73 10 1	
			331 0 7
			£1248 12 2

ASSETS.

I.	British Government Securities—		
	(a) £200 3½% War Stock at cost		£194 18 3
	(b) £258 2s. 6d. British Transport 3% Guaranteed Stock 1978-88 at cost		216 18 6
	(c) £100 3% Defence Bonds (4th Issue) at cost ...		100 0 0
	(d) £100 3½% Defence Bonds (Conversion Issue) at cost		100 0 0
	(e) £250 3% Savings Bonds 1965-75 at cost		253 18 3
			£865 15 0
II.	Bank Balances—		
	(a) Sum on Current Account with the Clydesdale and North of Scotland Bank Ltd. ...	£119 17 5	
	(b) Savings Account—Bank of Scotland Ltd.	31 4 11	
	(c) Edinburgh Savings Bank Account No. 129	115 13 0	
			266 15 4
III.	Grant due from Carnegie Trust		100 0 0
IV.	Income Tax Reclaim 1955-56		16 1 10
			£1248 12 2

EDINBURGH, 26th May 1956.—I hereby certify that I have audited the Accounts of the Treasurer of the Botanical Society of Edinburgh for the Session 1955-56, and have found them correct. I have also checked the foregoing Abstract and found it correct. I have seen the securities for the Invested Funds and found them in order.

(Sgd.) RONALD T. HUNTER, C.A., Treasurer.
(Sgd.) CHARLES A. SCOTT, C.A., Auditor.

SIR WILLIAM WRIGHT SMITH LECTURESHIP FUND.

SESSION 1955-56.

Balance of Fund brought forward from 1954-55		£300 9 8
Interest on £250 3½% War Loan	£8 15 0	
Interest—Edinburgh Savings Bank	2 19 5	
		11 14 5
		£312 4 1
Less Expenses—Dr. Ramsbottom		10 10 0
		£301 14 1

Being—

£250 3½% War Loan at cost	£203 12 0	
Edinburgh Savings Bank Account No. 312	98 2 1	
		£301 14 1

(Sgd.) RONALD T. HUNTER, C.A., Treasurer.

EDINBURGH, 26th May 1956.—I hereby certify that I have audited the Accounts of the Sir William Wright Smith Lectureship Fund for the Session 1955-56, and have found them correct. I have seen the securities for the Invested Funds and found them in order.

(Sgd.) CHARLES A. SCOTT, C.A., Auditor.

The PRESIDENT read the following proposed amendments to the Constitution of the Society (See *Trans. Bot. Soc. Edinb.*, (1946), **34**, 371):

(I) Chapter II, Section A, paragraph 3, delete "Fourteen Pounds" and substitute "Twenty Pounds".

(II) Chapter II, Section C, lines 5 and 6, delete "Five Shillings" and substitute "Ten Shillings".

The amendments were adopted unanimously, and the President instructed that the amended Constitution of the Society be published in the current number of the *Proceedings* of the Society. (See p. xxii.)

The following papers were read by title:

"Additions to the Flora of Eigg". By P. H DAVIS (see p. 111).

"The Machair Grazings of Tiree, Inner Hebrides". By P. B. VOSE, H. G. POWELL and J. B. SPENCE (see p. 89).

"Notes on Freshwater Algae, mainly from Lochs in Perthshire and Sutherland". By A. J. BROOK (see p. 114).

The SECRETARY, Mr. P. GREEN, submitted the following Report from Council:

The Membership of the Society stands at present at 323, made up as follows: 9 Honorary British Fellows, 19 Honorary Foreign Fellows, 236 Ordinary Fellows (of whom 88 have compounded for life), 28 Ordinary Members, 30 Lady Members and 1 Associate. During the year, 24 Ordinary Fellows and 7 Ordinary Members have been elected, 3 Ordinary Fellows resigned and 1 Honorary Foreign Fellow (E. D. Merrill, M.Sc., Ph.D.) and 4 Ordinary Fellows (A. A. Pinkerton, Sir David Russell, Professor J. Small and R. A. Taylor, D.Sc.) have died.

Eight ordinary meetings were held during the Session, that in October taking the form of the Wright Smith Lecture and that in February being a joint meeting with the Edinburgh Natural History Society. The Annual Cryptogamic Foray was held in the Nairn district from 24th to 26th September.

The Council wishes to express the indebtedness of the Society for grants of £100 from the Carnegie Trust for the Universities of Scotland towards the cost of publicaton of the *Transactions* and of £50 from the Russell Trust to the general funds. The latter grant was made through the kindness and interest of the late Sir David Russell.

Contributions to the illustration and other funds of the Society were received from Dr. Güssow, the Earl of Buchan, Mrs. Watt, and anonymous donators; all these are most gratefully acknowledged.

In view of the Society's financial position, the Council have given especial consideration through the year to the various expenditures and sources of income, and as a result the Council has recommended constitutional amendments allowing for an increase in the life composition fee for Fellows and the annual subscription of Ordinary Members. The Society's greatest expenditure is that on printing and as a result the Council have decided that in future the monthly notices of meetings shall be typed and cyclostyled instead of printed.

The printing of the *Transactions* is, in future, to be entrusted to Messrs. T. Buncle & Co. Ltd. of Arbroath, and the Council wish to express their gratitude to Messrs. Neill & Co. Ltd., who had acted as printers to the Society for over a century.

During the session a committee was appointed to consider the activities and membership of the Society. This committee made various recommendations which are being incorporated in the programme for the forthcoming session. In addition it was decided that a serious attempt should be made to stimulate attendance at field meetings and that a summer programme of excursions should be arranged. Mr. H. H. Davidian has agreed to act as Field Secretary and is arranging four field meetings during the summer. It was also decided that in addition to the monthly meetings held at Edinburgh from October to June, one indoor meeting a year should be arranged in Aberdeen, Glasgow or St. Andrews, for the benefit of the numerous Fellows resident outside the Edinburgh district. As a result, a meeting is being arranged in Aberdeen sometime during the coming session.

The Society have again been invited to send delegates to the Assembly of Corresponding Societies at the Meeting of the British Association, to be held this year in Sheffield. The Council have nominated Dr. Macdonald and Mr. Anthony. The Society has also been invited to nominate an observer at the forthcoming 5th General Assembly of the International Union for the Protection of Nature to be held in Edinburgh from 20th to 28th June. The Council have nominated Mr. Grant Roger as the Society's Observer.

BOTANICAL SOCIETY OF EDINBURGH

(FOUNDED 1836.)

Incorporating the CRYPTOGAMIC SOCIETY OF SCOTLAND.

JANUARY 1957.

I.—NAME AND OBJECT.

1. The name of the Society shall be "THE BOTANICAL SOCIETY OF EDINBURGH".

2. The object of the Society shall be the advancement of Botanical Science, by means of periodical meetings, publications, correspondence, and such other means as the Council may from time to time determine.

II.—MEMBERSHIP AND RIGHT TO VOTE.

1. The Society shall be open to Ladies and Gentlemen, and shall consist of Ordinary Fellows, Lady Members, Ordinary Members, Honorary Fellows and Associates.

2. Only Honorary and Ordinary Fellows shall have the right to vote in connection with the business of the Society.

(*a*) ORDINARY FELLOWS.

1. A candidate for admission as an Ordinary Fellow must present an application signed by two Fellows. The application shall be read at the proper time during private business, and shall be submitted at the next Ordinary Meeting.

2. Ordinary Fellows shall, on admission, sign the Laws, and pay the sum of One Pound to the funds of the Society; and shall contribute One Pound annually thereafter at the October Meeting. Ordinary Fellows are entitled to receive the *Transactions,* provided their subscriptions are paid.

3. Ordinary Fellows may at any time compound for their annual contributions by the payment of Twenty Pounds, less an amount equal to one-third of the annual subscriptions previously paid.

4. The Council shall take such measures as shall be deemed advisable regarding Fellows whose subscriptions are in arrears.

(*b*) LADY MEMBERS.

Any Lady may, on the recommendation of the Council, be elected a Member for life on payment of a single contribution of Three Guineas. Lady Members shall not be entitled to receive the *Transactions.*

(*c*) ORDINARY MEMBERS.

The Society may elect Ordinary Members on the recommendation of the Council. The name of any candidate shall be submitted to the Council and, if approved, shall be submitted for election at the next Ordinary Meeting. Ordinary Members shall pay the sum of Ten Shillings on admission, and shall contribute Ten Shillings annually thereafter at the October Meeting. They shall not be entitled to receive the *Transactions*.

(*d*) HONORARY FELLOWS.

1. The Council shall be privileged to propose Ladies and Gentlemen for election as Honorary Fellows. The names of those proposed shall be stated in the Billet calling the Meeting at which they are to be submitted for election. Any Fellow may submit to the Council the name of any individual whom he wishes to propose.

2. The Honorary Fellows shall be limited to twelve British subjects and twenty-five subjects of Foreign countries.

3. Honorary Fellows shall be entitled to all the privileges of Ordinary Fellows, and shall receive copies of the *Transactions* free of charge.

(*e*) ASSOCIATES.

The Society shall have power to elect, on the recommendation of the Council, as an Associate anyone who has rendered special service to the Society by transmitting specimens or botanical communications. Associates shall receive copies of the *Transactions* free of charge..

(*f*) METHOD OF ELECTION.

The names of candidates submitted for election to the Society shall be read from the Chair, and the candidate shall be declared duly elected unless a ballot is demanded. Any such ballot shall be taken at the next Ordinary Meeting of the Society. The ballot shall be determined by at least two-thirds of the votes provided fifteen Fellows are present and vote.

(*g*) DISCIPLINE.

In the event of any Member acting in such a way as shall seem detrimental to the interests of the Society, the Council may recommend that the name of such Member be deleted from the roll. In the event of the Council taking this action, the recommendation shall be brought before the next Ordinary Meeting of the Society and voted upon by ballot at the immediately succeeding Meeting when, if the recommendation be adopted by a majority of two-thirds of the votes of at least fifteen Fellows, the name of such person shall be deleted from the roll of Membership.

III.—OFFICE-BEARERS.

1. The general direction of the affairs of the Society shall be in the hands of a Council, consisting of a President, four Vice-Presidents, ten Councillors, a Secretary, an Assistant Secretary, a Cryptogamic Secretary, an Editor of *Transactions* and a Treasurer. Five shall be a quorum.

2. The Council shall be elected from amongst the Ordinary Fellows at the Annual General Meeting in June. They may be re-elected, except the two senior Vice-Presidents and the three senior Councillors who shall not be eligible for re-election to the same office till after an interval of one year.

3. The Secretary shall make notification in the Billet of the April Meeting of vacancies in the Council falling to be filled and shall invite nominations to fill these vacancies. Nominations may be made by any Fellow and together with the names of the proposer and seconder, shall be sent to the Secretary so as to reach him not later than the day before the Ordinary Meeting in May. To these nominations shall be added any made by the Council and the combined list shall be printed along with the Billet for the Annual General Meeting and shall be voted upon at that Meeting. Every Fellow present at the Meeting shall be entitled to vote.

4. The Council shall nominate annually an Auditor, to be recommended to the Society.

5. The Treasurer shall receive and disburse all money belonging to the Society, collecting the money when due, and granting the necessary Receipts. His accounts shall be audited annually by the Auditor appointed by the Society. It shall be the duty of the Treasurer to place all money belonging to the Society in one

of the Chartered Banks of this City, unless the same shall have been ordered by the Society to be otherwise invested; and he shall never keep more than Ten Pounds of the Funds of the Society in his hands at a time. The Bank Account shall be kept in the name of the Society, and all drafts thereon shall be signed by the Treasurer. The Treasurer shall submit annually a certified Statement of the Receipts and Expenditure of the past year, with the Auditor's Report thereon.

6. The Secretary, with the aid of the Assistant Secretary and the Cryptogamic Secretary, shall give intimation of all General and Committee Meetings, shall Minute their proceedings in Books to be kept for the purpose, and shall conduct all the Society's Correspondence. He shall also take charge of all Donations of Plants and Books, and shall see them deposited in the Herbarium and Library, in conformity with any arrangements made by the Society with Government.

7. The Council shall have the power to fill any vacancy which may occur during the year.

Note.—Agreeably to an Act of the Town Council of the City of Edinburgh, dated January 8, 1839, the Professor of Botany in the University of Edinburgh is constituted Honorary Curator *ex officio*, with free access to the Society's Collection, whether a Member of the Society or not.

IV.—MEETINGS.

1. An Ordinary Meeting of the Society shall be held every month from October to May; normally on the second or third Thursday of each month.

2. An Annual General Meeting shall be held each year in June at which the following business shall be transacted:

   (a) Presentation by the Council of a Report on the work of the Society during the past year.
   (b) Presentation of a financial statement by the Treasurer.
   (c) Election of the Office-Bearers for the ensuing year.
   (d) Any other business.

3. Any Member may transmit to the Society Papers and Communications, which, if approved by the Council, may be read by the author, or, in his absence, by the President or Secretary, at any of the Ordinary Meetings.

4. Minutes shall be kept of the Meetings of the Society and of the Council, and the Minutes of each Meeting shall be read as the first business of the next ensuing Meeting of the same kind.

5. Each fellow shall have the privilege of admitting a Visitor to the Ordinary Meetings of the Society at the close of the private business.

6. An Extraordinary Meeting of the Society may be called at any time, by authority of the Council, at the request of three or more Fellows.

7. The Council shall hold a Meeting for business either before or after each Ordinary Meeting of the Society unless the President shall otherwise determine. The Council may at any time be called upon by the President or any two of the Vice-Presidents or Secretaries, to meet for the transaction of business.

V.—PUBLICATIONS.

1. The Society shall publish *Transactions* and *Proceedings*. The consideration of the acceptance, reading, and publication of all papers is vested in the Council, whose decision shall be final. For the consideration of each paper the Council shall appoint two Referees, who shall submit their reports to the Council through the Editor of the *Transactions*. Acceptance for reading shall not necessarily imply acceptance for publication.

2. The Council may from time to time fix special prices for the sale of copies of the *Transactions* to Fellows, Members, and Associates.

VI.—ALTERATION OF CONSTITUTION AND RULES.

Any motion for the alteration of the Constitution and Rules must be intimated to the Council, and shall be printed in the Billet calling the Meeting at which it is to be brought forward, and in the Billet of the Meeting at which it is to be considered. It shall then be determined by a majority of at least two-thirds of the votes provided at least fifteen Fellows are present and vote.

TRANSACTIONS
OF THE
BOTANICAL SOCIETY OF EDINBURGH

SESSION CXX

FURTHER OBSERVATIONS ON THE BRYOPHYTE FLORA OF THE ISLE OF MAY. 1. THE AMENDED LIST.

By E. V. WATSON.
(Dept. of Botany, University of Reading.)

(Read by title, 17th January 1957.)

It is the purpose of this paper to bring up to date the annotated list of the Bryophytes of the Isle of May, Firth of Forth, which appeared four years ago (Watson, 1953). That list correlated the findings of earlier observers with such observations as I had been able to make myself, and established the occurrence of 43 species and 2 additional varieties of Musci and 12 species of Hepaticae on the island.

Further visits were made to the Isle of May in September 1955 and May 1956, in the main with a view to carrying out some ecological work the results of which it is hoped to publish separately at a later date. Rather surprisingly, however, these visits have produced no fewer than 8 species and one variety of moss and 6 species of liverwort new to the island, and at the same time have necessitated a re-assessment of the status of some of the plants already known to occur.

The principal physical features and available habitats of the Isle of May were considered in the earlier paper, and no repetition is needed here. Nevertheless, the fact that this small island, presenting as it does no great variety of available habitats, should produce 14 additional species of bryophyte at this stage does call for a word of comment and explanation. For it must be remembered that bryophytes have been under observation at this station for upwards of 70 years, and if the collecting has been often enough spasmodic and casual rather than intensive and systematic, it did begin with the carefully prepared lists of the late William Evans, an observer who knew these small plants well and who is likely to have spared no pains to make the list as complete as possible (Evans, 1908, 1910). The present notable increment of species is, in my view, largely attributable to two causes. The first lies in the increased amount of disturbed land, resulting in the exposure of ever more free surfaces of substratum for colonisation by spores; the second is undoubtedly the fact that at no time prior to September 1955 were the unique possibilities of Colm's Hole as a source of bryophyte habitats fully appreciated. This little north-east facing hollow, situated on the east of the island a few hundred yards south of Dunvegan, is apt to be overlooked. Like a miniature corrie in form, it is in fact extremely rich in potential "niches" for bryophytes and is not matched by any stretch of terrain elsewhere on the island. I hope to develop this theme more fully on another occasion; suffice it to point out here that 5 of the new records come from Colm's Hole, which at the same time supports overwhelmingly the richest development of at least 4 more of the island's most elusive species.

Perhaps the most remarkable new finds are the plants which after some consideration have been referred respectively to states of *Porella cordeana* and *Anthoceros husnoti,* although almost equally interesting is the addition of *Hookeria lucens* to the list. Despite what now amounts to a fairly thorough search, there remain some remarkable "absentees", among them the very common liverwort *Diplophyllum albicans* and the moss *Pleurozium schreberi.* Other species would appear to have had only a transitory existence on the island. Thus, after a lapse of six years, it proved impossible to find any trace of the small colony of *Sphagnum plumulosum* that had been discovered in 1949.

The list that follows contains only those species which call for an amended statement, together with all those that are new to the Isle of May. The latter are marked with an asterisk (*).

MOSSES.

POLYTRICHUM PILIFERUM Hedw. Probably rarer than *P. juniperinum*.

FISSIDENS BRYOIDES Hedw. More widespread than was formerly realized; cave at South Ness; Colm's Hole; ditch near West cliffs, etc. I have still not succeeded in establishing the presence of *F. viridulus* on the island although it alone in this genus was recorded by Evans.

*PSEUDEPHEMERUM NITIDUM (Hedw.) C. Jens. In very small amounts, with a few ripe capsules, on the nearly vertical bank of a dried out pool, South Plateau, Sept. 1955.

CERATODON PURPUREUS (Hedw.) Brid. Barren tufts are extremely widespread and abundant in many parts of the island. In a very few sites, plants with capsules were found in May 1956. On the rather rare tufts where they occurred the capsules were produced in great profusion.

*TORTULA RURALIS (Hedw.) Crome. Barren plants in rather small quantity, on rocky, disturbed ground immediately south of the Beacon.

POTTIA HEIMII (Hedw.) Fürnr. Close inspection of the margins of cinder tracks showed this species to be rather plentiful, and producing capsules freely; near West landing, near Kirk Haven, south bank of loch, etc.

P. ASPERULA Mitt. This species, recorded more than 40 years ago by Evans, has been re-found in small quantity, with capsules, on the north bank of the loch. This is a dry habitat, subject to intense isolation during spells of anticyclonic weather in summer; it is able to support few bryophytes.

BARBULA UNGUICULATA Hedw. Commoner than formerly supposed, perhaps increasing; locally abundant near habitations. It will be recalled that neither this species nor *B. convoluta* appeared in Evans' list. It would be difficult for either to escape the notice of a visiting bryologist today.

FUNARIA HYGROMETRICA Hedw. Locally rather plentiful as a colonist of fired land, it has a status which is apt to fluctuate from year to year. Old "fruiting" plants were not hard to find in 1955 or 1956 but extensive, vigorous colonies were lacking.

PHYSCOMITRIUM PYRIFORME (Hedw.) Brid. Recorded by Evans, but not since, it was re-found in May 1956. The plants grew in "Pat's Puddle" by Dunvegan, and capsules were abundant.

*BRYUM PENDULUM (Hornsch.) Schp. Thanks to the presence in May 1956 of abundant ripe capsules on a colony of Bryum a few square yards in extent near Kirk Haven it has been possible to establish this species as definitely occurring on the island. The status of *B. inclinatum* remains equivocal.

*BRYUM CAESPITICIUM Hedw. Plants with ripe capsules taken from disturbed ground beside concrete slab, just West of Low Trap, May 1956.

Bryum alpinum With. Fuller investigation has shown that this species has four distinct sites on the island. Of the two already reported, that on the North Plateau is now very small in extent. The largest and most flourishing colony is at the foot of Colm's Hole. A small colony was located on the north-facing embankment of the loch in May 1956.

Bryum capillare. This proves to be locally common in the vicinity of Dunvegan and the Old Observatory (The "Look-out"). Also found on the site of a gull's nest, Rona.

Mnium hornum Hedw. Abundant ripe capsules were detected at the Holyman's Road site in May 1956.

*Mnium punctatum Hedw. Found in very small amounts, and far from vigorous in habit, in a shaded recess in Colm's Hole, Sept. 1955.

*Hookeria lucens (Hedw.) Sm. Occurs concealed from view in several of the shaded recesses of the N.E.-facing slope at Colm's Hole.

*Leptodictyum riparium (Hedw.) Warnst. Sterile plants were found in a drainage ditch near the West landing, September 1955, and on a local patch of ill-drained ground, just west of the Low Trap, May 1956.

*Amblystegium serpens (Hedw.) B. & S. In small amounts, intermixed with other mosses, in turf east of the path at the top of "Palpitation Brae", May 1956.

Drepanocladus fluitans (Hedw.) Warnst. My impression is that it is losing ground on the island. At the present time I know of only one extensive patch of it—i.e. on the edge of the West Cliff, South Plateau, and at this site it shows signs of suffering seriously from "drying out".

Isothecium myosuroides Brid. var. brachythecioides (Dix.) C. Jens. I am satisfied that the plants of this species on the Isle of May are indeed referable to this well-marked robust variety. I found it to be abundant on the lower rock ledges of Colm's Hole. It also occurs in smaller amounts near the south of the island. Being local, previous to 1955 it had escaped my notice, but it will be recalled that as long ago as 1885 Evans discovered plants which were thought by Dixon to approach this variety.

Camptothecium sericeum (Hedw.) Brid. Now known from at least three sites on walls; also extending to rocky ground by the lighthouse; possibly on the increase.

Brachythecium albicans (Hedw.) B. & S. This species is now locally rather plentiful in partly eroded turf near the lighthouse.

Brachythecium rivulare (Bruch) B. & S. This survives in what I believe to be greatly diminished amounts in the small area of marshy ground remaining in the precincts of "Pat's Puddle".

Plagiothecium undulatum (Hedw.) B. & S. This species, in Evans' 1910 list, is now known to survive in some quantity on the steep embankment of Holyman's Road near Dunvegan.

Hypnum cupressiforme Hedw. In addition to the typical form and varieties *resupinatum* (Wils.) Schp. and *ericetorum* B. & S., already recorded, a further form has been found in the eroded turf just West of the lighthouse gardens, in May 1956. This has numerous erect, tumid secondary stems and very concave, nearly straight leaves: it seems best referred to *var. *tectorum* Brid.

Rhytidiadelphus squarrosus (Hedw.) Warnst. This early find of Evans long eluded subsequent observers. It has now been found, rather sparingly, in the turf at Colm's Hole and at one site South of Kirk Haven.

LIVERWORTS.

***Calypogeia fissa** (L.) Raddi. In small amounts, on moist soil of shaded recesses, Colm's Hole.

Nardia scalaris (Schrad.) Gray. More widespread than formerly supposed in suitable habitats, especially banks of dried out pools.

Plagiochila asplenioides (L.) Dum. var. **humilis** Lindenb. Plants which are in all likelihood the same as those recorded under this name by Evans have now been taken from the steep north-facing embankment of Holyman's Road, near Dunvegan. The form is a small one, the leaf margin entire or at most sinuate; but I am uncertain whether it can with confidence be assigned to this variety.

Porella cordeana (Hüb.) Evans. The occurrence of what seems to be this species on a comparatively dry rocky site beside the Beacon is somewhat surprising. Depauperate male plants alone were found (May 1956), and although from the distant underleaves and small postical lobules they would appear to be this species, they are far from the typical form. Indeed, they approach var. *faeroensis* C. Jens.

Frullania germana Tayl. Localized in the lower part of the Colm's Hole amphitheatre, this species (long ago detected by Evans) was found in 1955 to grow in that one site in some quantity.

***Riccardia sinuata** (Dicks.) Trev. Fragmentary amounts of a species of *Riccardia* that appear best referred to this species have appeared in Colm's Hole and near "Pat's Puddle".

***Pellia epiphylla** (L.) Corda. This species was found in 1955 to occur in small amounts in the cave at the south end of the island.

***Marchantia polymorpha** L. In May 1956 a flourishing colony, with numerous gemma cups, was located between the water tank and the wood bunker at Dunvegan—an interesting addition to the "viatical" element in the flora of the island.

***Anthoceros husnoti** Steph. On the characters of the thallus, barren material of *Anthoceros* found in 1949 on the North plateau was assigned to *A. laevis*. The material was scanty but there seems no reason to change that opinion. In September 1955 fertile plants of a black-spored *Anthoceros* were taken from a shaded ledge in Colm's Hole. The plants did not bear especially large sporophytes (up to 2·3 cm.), but the scarcely ripe bodies of the antheridia attained 105μ in length and the thallus reached a thickness of 16 to 18 cells. According to Proskauer (1948) the antheridial bodies of *A. punctatus* do not attain this size; nor are the thalli of that species so many cells in thickness. I have therefore no hesitation in referring these specimens to a small state of *A. husnoti*.

The present contribution brings the total of the bryophytes known from this small island up to 72 taxa.

ACKNOWLEDGMENTS.

I would thank the Committee of the Isle of May Bird Observatory for making possible my two recent stays on the island. I am indebted to Dr. W. J. Eggeling in particular for the keen interest he has shown in the work and the setting up of a reference collection of bryophytes at the Observatory. Finally, I wish to thank Dr. E. W. Jones for kindly expressing an opinion on some of the liverworts, notably *Porella cordeana*.

REFERENCES.

EVANS, W. (1908). Some Mosses and Hepatics from the Isle of May. *Trans. Bot. Soc. Edinb.*, **23**, 348.

EVANS, W. (1910). Some further Mosses and Hepatics from the Isle of May. *Trans. Bot. Soc. Edinb.*, **24**. 91.

PROSKAUER, J. (1948). Studies in the Morphology of Anthoceros I. *Ann. Bot., Lond.*, N.S., **12**, 237.

WATSON, E. V. (1953). Observations on the Bryophyte Flora of the Isle of May. *Trans. Bot. Soc. Edinb.*, **36**, 165.

THE MACHAIR GRAZINGS OF TIREE, INNER HEBRIDES.

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(Read by title, 14th June 1956.)

The machair, a semi-natural grassland derived from shell sand, is one of the few semi-natural grasslands of any extent in Britain. It is most common on the exposed western shores of the Hebrides, in Sutherland, and in small areas locally elsewhere on the west coast of Scotland. A distribution map of the machair has been compiled by Fraser Darling (1947), and general accounts have been given in MacVicar (1898), Wilmott (1945), Fraser Darling (1947, 1955), MacLeod (1948), and from the agronomic aspect by Kerr (1954).

The literal translation of the Gaelic *machair* (*machar, machaar*) is heath, but in fact the crofter uses the term to include what may be regarded as a complex of seral stages, passing from unstable dune, through fixed dune and machair proper until, under natural conditions, *Calluna* heath is reached. The term is also frequently applied to arable land, either enclosed or unenclosed, which has been developed from the machair. In the present paper the term is applied to the region immediately adjacent to the dunes where the psammophilous dune grasses have been eliminated, and which in the case of siliceous dunes is commonly referred to as dune pasture or links.

The machair of Tiree, as elsewhere, forms an essential adjunct to the economic existence of the crofting townships. Each croft has its own small area of enclosed land but also possesses grazing rights in common on the unfenced machair, the "souming", or permitted number of grazing beasts being proportional to the size of the croft and other factors.

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GEOLOGY.

The geology (Ordnance Survey, 1926) of Tiree is relatively simple, consisting of a basal complex of Lewisian Gneiss whose outcropping is largely concealed by raised beach deposits and blown sand. On the extreme S.W. point of the island an outcrop of garnet gneiss is partly covered by blown sand and flanked by hornblende biotite gneiss, which forms the majority of the rock outcrops. Dark hornblende-augite gneiss outcrops west of Hynish, east of Ceann a'Mhara, on Balephetrish Bay and on Salum Bay. The country rock in the west of the island is largely concealed by raised beach deposits 25 ft. to 100 ft. (7·6 to 30·4 m.) above sea level, while to the N.E. and N.W. of Gott Bay are similar deposits.

The soil of the island thus has two different origins (a) a relatively siliceous drift formed by weathering of the country rock, and (b) a young calcareous soil formed by consolidation of the shell sand.

CLIMATE.

Tiree receives the full force of the winds from the Atlantic, but the three small hills are rarely able to gather the clouds sufficiently to cause rain, the annual rainfall being about 40″ (127 cm.), the months of January and October showing the heaviest precipitation. (Meteorological Office 1920-4, 1952).

The island has a high number of hours of bright sunshine and has recorded the highest monthly percentage in Scotland for as many as six months in the year. The surrounding ocean modifies the temperature which rarely averages more than 60° F. in summer or less than 40° F. in winter, 5° of ground frost being unusual. Tiree has more hours of wind from the South and East than from any other direction and has often recorded the strongest gusts in Scotland.

PROCEDURE.

The main line of approach was a detailed investigation of the machair at Balinoe, this being representative and also technically suitable, as the whole succession could be covered by a relatively short transect of 1650 ft. (501·6 m.). Comparative work, particularly vegetation analysis, was done at Balephuil Bay, and other machairs of any size were inspected for local variation.

Botanical analysis consisted of an estimate of cover percentages and frequency, with twenty-five quadrats being thrown at random for cover percentage and fifty for frequency, using a 15 × 15 cm. quadrat. In the tables, cover percentages of less than three are not shown.

At Balinoe, a line transect was marked out (see Fig. 1) from Mean High Water Mark Ordinary Spring Tide to a point 1650 ft. (501·6 m.) inland, levels being taken throughout. Six stages in formation and development of the machair were recognised, Mobile Dune, Stable Dune, Fixed Dune, Young Machair, Mature Machair and Old Machair. Additionally, the machair at Balinoe shows a transition to marsh which is typical of wet places adjoining the machair throughout the island. These six stages, together with the Transition Region and the Marsh, were considered for the purpose of study as eight zones. The delimitation of these zones is shown in the species lists, and in Table 6, together with relative heights along the transect.

Quadrats were thrown within an area 60 ft. (18·2 m.) on each side of the transect, and samples of soil for the determination of pH, calcium carbonate, loss on ignition, water content, and water capacity were taken within the transect in two or three parallel series each 30 ft. (9·1 m.) apart.

Calcium carbonate was determined by Collins' calcimeter method, pH by B.D.H. capillator immediately after sampling, and loss on ignition by heating at 400° C. in a muffle furnace. Water capacity is taken as the amount of water, expressed as a percentage of the dry weight, retained by a sample after it had been immersed in water.

THE BALINOE MACHAIR.

The dunes at Balinoe, which are neither so extensive nor so high as those which precede some other machairs, slope up gradually for a distance of 200 ft. (60·8 m.) inland where they reach a height of 30 ft. (9·1 m.), merging imperceptibly into the machair. It is clear that at Balinoe active accretion has virtually ceased as the mobile dune region is now little more than 25 ft.

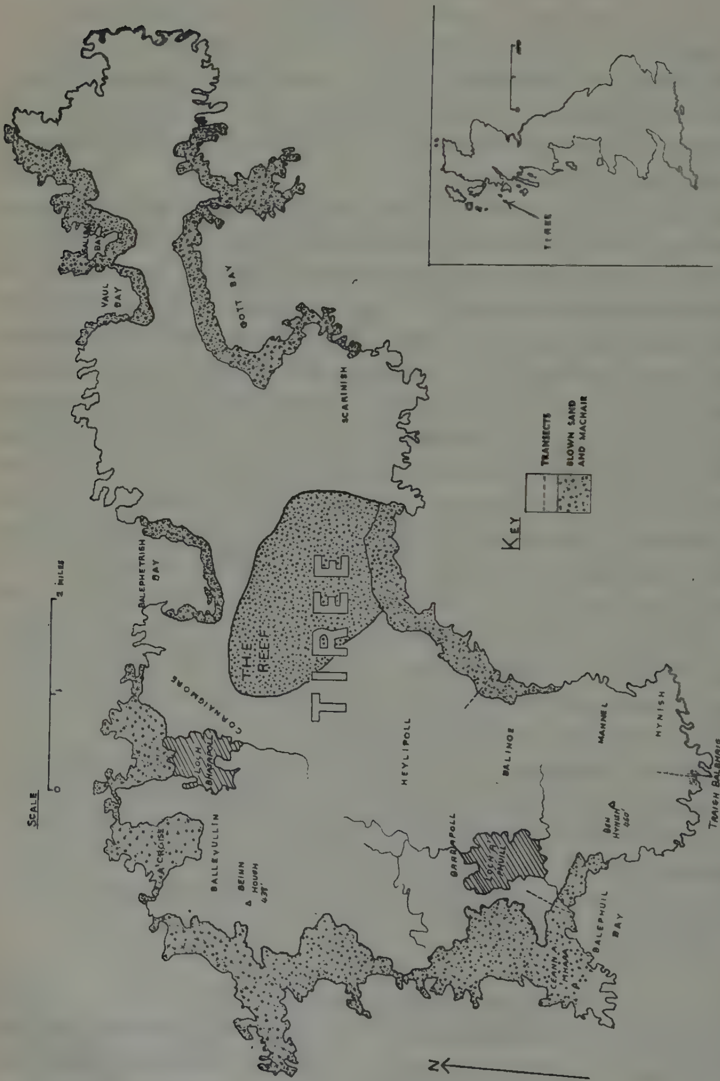

Fig. 1.

Map of Tiree showing the location of the transects and the distribution of blown sand and machair.

5 m.) wide. There is therefore a long-established machair, the sis of which is a very old dune system which has long since t its identity, the crest being reached 950 ft. (289 m.) inland. sharp drop from this crest followed by the ground sloping away d becoming progressively wetter, leads to the characteristic achair flora, giving way to one of marsh type.

A foreshore community of sparse patches of *Honkenya ploides* and small amounts of *Agropyron junceiforme* precedes mobile dunes, but other foreshore and driftline plants like *riplex glabriuscula, Cakile maritima* and *Salsola kali* are absent re though noted in other areas.

Mobile Dune: As shown in Table 1, *Agropyron junceiforme* nounted to about 12% of the cover, while *Taraxacum evigatum,* though of low frequency, accounted for 5%, owing its habit of forming large rosettes when unhindered by mpetition. The individual cover of the other plants was gligible, while the entire absence of *Ammophila arenaria* was usual and is referred to later.

Stable Dune: The chief features of this associes in comparison th the previous one are the sharp decline in the area of bare ound and of the frequency of the purely psammophilous ecies. The pasture species which have come in comprise *Lotus rniculatus* with a frequency of 64%, *Poa trivialis, P. pratensis, rostis stolonifera* and *Lolium perenne.*

Fixed Dune: As seen in Table 1, invasion by moss species s taken place, though these remain relatively unimportant in e general complex. *Tortula ruraliformis,* however, forms local cieties anything from 1 to 6 ft. (0·3 to 1·8 m.) across, in places nere, owing to treading by cattle or other causes, the surface the sward has become broken and a bare patch has formed.

Agropyron now occurs only as odd, poverty-stricken shoots, d the sward blends almost imperceptibly into the community the Young Machair.

Young Machair: This associes, as is brought out in Table 2, a Festucetum rubrae, with *Trifolium repens, Plantago nceolata* and *Lotus corniculatus* as sub-dominants.

Despite a fairly high cover percentage, *Senecio jacobaea* nnot be considered a sub-dominant owing to its relatively low equency.

TABLE 1.
BALINOE MACHAIR: DUNE ANALYSIS.

SPECIES.	MOBILE DUNE. (25-53′)*		STABLE DUNE. (53-100′)*		FIXED DUNE. (100-160′)*	
	Frequency	Cover %	Frequency	Cover %	Frequency	Cover %
BARE GROUND	100	75	98	27·2	88	21·6
AGROPYRON JUNCEIFORME	88	12	40	4	26	
CAREX ARENARIA	42		26		36	
HONKENYA PEPLOIDES	24					
RUMEX CRISPUS	18		2			
CARDUUS ARVENSIS	18					
POTENTILLA ANSERINA	14					
RANUNCULUS SPP.†	12		48	4·6	54	
GALIUM VERUM	12		41	16·7	96	10·5
FESTUCA RUBRA**	10		60	3	98	19·6
TRIFOLIUM REPENS	10		70	3	90	8·5
TARAXACUM LAEVIGATUM	8	5	14			
PLANTAGO LANCEOLATA	4		44	9·5	78	7·3
SENECIO JACOBAEA	2		6	3	18	
ACHILLEA MILLEFOLIUM			66	3	58	
LOTUS CORNICULATUS			64	3	94	14·3
POA TRIVIALIS			38		50	
AGROSTIS STOLONIFERA			30		44	
POA PRATENSIS			28		18	
LOLIUM PERENNE			6		22	
CERASTIUM SEMIDECANDRUM			4		32	
TORTULA RURALIFORMIS					28	
BELLIS PERENNIS					34	
CYNOSURUS CRISTATUS					14	
POHLIA NUTANS					12	
LUZULA CAMPESTRIS					8	
ACROCLADIUM CUSPIDATUM					6	

*Position on the transect measured from High Water.
†*Ranunculus* spp. not estimated separately. Principally *R. bulbosus*

Festuca rubra	100	27·8	98	20	100	16·8
Trifolium repens	98	13·7	96	12	96	8·6
Senecio jacobaea	56	12·3	36	1·7	32	2·4
Plantago lanceolata	92	11·3	90	13·1	88	3·8
Lotus corniculatus	82	10·6	68	6·1	80	5·4
Galium verum	82	5·5	82	5·3	70	
Ranunculus spp.	64	4·9	88	5·7	86	
Bellis perennis	70	3·4	78	7	80	
Lolium perenne	44		50		50	
Achillea millefolium	36		10		4	
Poa pratensis	36		20		24	
Rhytidiadelphus squarrosus	34		72	5·5	42	
Cynosurus cristatus	34		40		72	6
Luzula campestris	34		64		54	
Agropyron junceiforme	32		36		22	
Agrostis stolonifera	28		18		16	
Tortula ruraliformis	20					
Pohlia nutans	20		18			
Cerastium semidecandrum	18		32		22	
Bare ground	16		6			
Carex flacca	14		64		78	6·4
Taraxacum laevigatum	10		12		26	4·1
Euphrasia officinalis agg.	10		30		50	
Acrocladium cuspidatum	6					
Holcus lanatus	6		30		48	7·2
Prunella vulgaris	2		22		8	
Trifolium medium	2		24		12	
Rhinanthus minor	2		6		18	
Mnium cuspidatum			42		48	
Koeleria gracilis			26			
Plantago coronopus			10		16	
Thymus serpyllum agg.			4		2	
Plantago maritima					8	
Poa trivialis			2			
Trisetum flavescens			2			
Daucus carota			2			
Sagina maritima			2			
Equisetum palustre					14	

*Position on the transect measured from High Water.

Of the additional species, apart from *Ranunculus acris, Carex flacca* has the widest range of any machair species, being found growing elsewhere alongside *Molinia caerulea.*

The significance of the frequency of *Lolium perenne, Poa pratensis* and *Cynosurus cristatus,* coupled with their small cover, is discussed later in relation to grazing.

Mature Machair: In general appearance the mature machair is little different from the young machair community. Close examination, however, shows the virtual absence of bare ground and an increase in the number and frequency of the least valuable grazing species, particularly the mosses and *Euphrasia* spp. Of the additional species, *Koeleria gracilis* is quite widespread, and though observed in other machairs, occurs in no other associes at Balinoe. The machair is low, undulating, treeless and heavily grazed, and apart from the ragwort, resembles a vast, closely mown fairway of a golf course.

Old Machair: This community is characteristic of the influence that damper conditions and a lowering of pH have on a mature machair. The increase in *Holcus lanatus, Carex flacca, Cynosurus cristatus* and *Taraxacum laevigatum* will be noted (Table 2).

Transition Region: This community is typical of the many areas of machair on the island which are liable to flooding when there is a sudden rise in the level of streams or shallow lochs. These are subject to considerable changes in level following heavy rain, as the soil covering the rock platform which forms the island is quite shallow. The decline of *Festuca rubra,* hitherto the dominant species except in the dune associes, is striking, as is that of *Lotus corniculatus.* The change to marsh is quite sharp.

Marsh: This society is frequently associated with the machair and shows the effect of a normally high but fluctuating water table on the characteristic complex of the true machair. Most of the machair species remain but their proportions and relative importance are considerably altered (Table 3). *Iris pseudacorus* is widespread, being associated mainly with *Ranunculus acris, Holcus lanatus, Equisetum palustre* and *Anthoxanthum odoratum.*

This pattern of machair developing through seral stages of mobile dune and fixed dune is typical, with variations such as

TABLE 3.

BALINOE MACHAIR: MARSH ANALYSIS.

SPECIES.	TRANSITION REGION. (1100-1450′)*		MARSH. (1450-1650′)*	
	Frequency	Cover %	Frequency	Cover %
US LANATUS	84	16·2	78	7·8
NCULUS SPP.	96	12·0	94	21·0
CA RUBRA	82	9·9	66	4·3
LIUM REPENS	98	8·3	41	6·0
K FLACCA	90	7·3	100	12·3
TAGO LANCEOLATA	64	5·0	40	6·9
XACUM LAEVIGATUM	60	4·4	24	
RASIA OFFICINALIS AGG.	46	4·0	4	
JM PERENNE	50	3·8	28	
STIS STOLONIFERA	44	3·4	32	
SURUS CRISTATUS	60	3·3	46	3
S PERENNIS	54		38	4
ELLA VULGARIS	36		22	
S CORNICULATUS	36		4	
PRATENSIS	32			
M CUSPIDATUM	30		18	
ETUM PALUSTRE	30		74	6·3
LIUM MEDIUM	26		58	7·0
JM VERUM	26			
LA CAMPESTRIS	26		2	
IA NUTANS	22		10	
OCOTYLE VULGARIS	16		18	
ANTHUS MINOR	14			
AUREA NIGRA	14		10	
TRIVIALIS	12		4	
STIUM SEMIDECANDRUM	12		2	
US BUFONIUS	12		18	
TAGO MARITIMA	10		4	
ALLIS TENELLA	10			
OXANTHUM ODORATUM	10		30	
CIO JACOBAEA	6			
NTILLA ANSERINA	6			
TAGO CORONOPUS	4			
IDIADELPHUS SQUARROSUS	4		6	
NTHE LACHENALII	2		8	
US CAESPITOSUS	2		12	
IS MACULATA AGG.	2		4	
US SERPYLLUM AGG.	2			
NIS FLOS-CULI			24	
SEPIUM			18	
CLADIUM CUSPIDATUM			18	
PSEUDACORUS			12	
OCHIN MARITIMA			6	
CAGO LUPULINA			4	
AMINE PRATENSE			4	
IO AQUATICA			2	

*Position on the transect measured from High Water.

those involving the relative importance and extent of the dune associes.

BALEPHUIL BAY AND OTHER MACHAIRS.

At Balephuil Bay (Fig. 1), a more extensive dune system precedes the machair, the fixed dunes rising to a crest 30 ft. (9·1 m.) high some 400 ft. (121 m.) inland, followed by a level stretch with a second, lower, crest about 2000 ft. (608 m.) inland. The machair proper commences about here, the ground sloping away until the seaward margin of Loch a'Phuil is reached.

In the low mobile dunes *Agropyron junceiforme* is, as before, the pioneer, but unlike Balinoe, in the more mature dunes *Ammophila arenaria* is present. These two species are present in approximately equal amounts, the two together covering about 10% of the ground. A full list is given in Table 4. Though the vegetation of the fixed dune associes follows the general pattern as in the Table, there are frequently societies of *Anthyllis vulneraria,* 2-9 ft. (0·6-2·7 m.) across, particularly in moist hollows. Frequently too, these hollows are entirely free from *Ammophila* but with a high percentage of *Lolium perenne, Lotus corniculatus* and *Trifolium* spp. Occasionally *T. dubium* is found on the drier parts and on the machair proper.

The composition of this machair is similar to that of the mature association at Balinoe, though *Festuca rubra* is more dominating, due to the sub-dominants declining as individual species and being replaced by species previously of little account.

Local variations in the machair are frequent, one area at Mannel for instance, having 50% *Trifolium repens* with considerable *Lolium perenne* and *Cynosurus cristatus.* The highest grades of machair, from a grazing point of view, are those at Cornaigmore and near Loch Bhasapoll. These machairs tend to have a higher percentage of *Trifolium repens* and *Lolium perenne* than at Balinoe, together with unusual amounts of *Trifolium pratense* and *T. medium,* particularly at Cornaigmore.

Grass fields which have been derived by enclosure from the machair retain a similar composition, but *Lolium perenne* with *Trifolium repens* tends to dominate, while *Holcus lanatus* occurs in damp depressions. *Ranunculus acris* and *Anthoxanthum odoratum* are present throughout, and *Arrhenatherum elatius,* which is not usually found on the machair as it cannot stand the

TABLE 4.

BALEPHUIL BAY: ANALYSIS OF THE ASSOCIES.

Species.	Mobile Dune.	Fixed Dune.		Machair.	
	Frequency	Frequency	Cover %	Frequency	Cover %
Ammophila arenaria	A	92	9	4	
Agropyron junceiforme	A	2		4	
Atriplex glabriuscula	O				
Carex arenaria	F	22		10	
Cirsium arvense	F				
Honkenya peploides	O				
Plantago lanceolata	F	74	9·8	94	9
Potentilla anserina	F				
Ranunculus spp.	F	80		54	
Rumex crispus	F				
Sedum acre	O				
Sonchus asper	O				
Taraxacum laevigatum	O	6		24	
Trifolium repens	O	100	27	98	8
Festuca rubra		98	23	100	21
Galium verum		90	7·8	84	8·7
Bellis perennis		52	3·8	72	5
Achillea millefolium		62	3·8	48	
Lolium perenne		24		76	4·7
Cerastium semidecandrum		24		20	
Lotus corniculatus		18		72	3·5
Thalictrum minus ssp. arenarium		18			
Bare ground		14			
Luzula campestris		14		46	
Poa pratensis		6			
Trifolium medium		6		28	6
Daucus carota		4			
Cynosurus cristatus		4		72	
Rhytidiadelphus squarrosus		2		60	6
Senecio jacobaea		2			
Poa trivialis		2		8	
Bromus mollis		2			
Anthyllis vulneraria		Occasional			
Trifolium dubium		,,			
Eryngium maritimum		,,			
Coeloglossum viride				Single plant	
Euphrasia officinalis agg.				88	6
Holcus mollis				68	4
Carex flacca				74	4
Agrostis stolonifera				34	
Prunella vulgaris				32	
Mnium cuspidatum				26	
Centaurea nigra				16	
Thymus serpyllum agg.				12	
Pohlia nutans				4	
Equisetum palustre				4	

heavy grazing, is quite a frequent constituent. A poorly-drained field adjoining the open machair at Cornaigmore had a cover of 40% *Trifolium pratense* and *T. medium,* 30% *Phragmites communis* and 30% *Equisetum palustre.* This field was grazed by sheep, so that the *Phragmites* under the influence of constant grazing was no more than 18 ins. to 24 ins. (45 cm. to 60 cm.) in height.

Under the conditions prevailing on Tiree today, fully-established machair is maintained as permanent pasture, while in former days some areas have been enclosed and developed as arable. Thus further succession from the plagioclimax is difficult to observe, but at Traigh Balbhaig there is some evidence of a succession to heath. A normal machair develops from discontinuous, low and irregular *Ammophila* dunes, rising inland, at first gradually, then more steeply. As it rises, the amount of *Anthoxanthum odoratum* and *Holcus lanatus* increases, while *Trifolium repens* and *Lotus corniculatus* decline. Then *Sieglingia decumbens* appears, followed by *Molinia caerulea* and patches of *Nardus stricta,* this in its turn giving way to *Calluna vulgaris.* The growth form of the *Molinia* is similar to the variety *depauperata* Lindle. (*M. varia* Schrank.) which was recognised by Smith (1900) and others (Smith, 1903; Jeffries, 1915) as a distinct type, being smaller 8-15 ins. (20-38 cm.) and without the characteristic tussock-forming habit of the normal form. *Calluna* and *Molinia* continue as the main species of the heath association, though it is very irregular and shows little uniformity, while in addition the following are frequent:—*Eriophorum vaginatum* and *E. angustifolium, Carex flacca, C. fulva, C. nigra* and *C. echinata, Juncus squarrosus, J. bufonius* and *J. articulatus, Potentilla erecta, Erica tetralix* and *Salix repens.* The last occurs sporadically, but is fairly well distributed. In the wetter depressions and hollows *Sphagnum* spp. may be present.

TABLE 5.

GRAIN SIZE OF A COMPOSITE SAMPLE OF SURFACE (0-6″) SAND OF AN UNSTABLE DUNE AT BALINOE.

DIAMETER OF GRAINS.	% COMPOSITION.	DESCRIPTION.
Over 1 mm.	0·9	Readily visible as shell particles
0·5-1 mm.	3·7	Visible as shell
0·15-0·5 mm.	81·4	Just visible as shell
Less than 0·15 mm.	14·0	Not visible as shell

THE MACHAIR HABITAT.

Edaphic Factors: The sand is mainly shell in origin, and has a calcium carbonate content of 66-70%. As shown in Table 5, the size of the grains tends to be small, while of the particles over 1 mm. in diameter a number consist of aggregations. Table 6 shows the percentage of calcium carbonate by weight, and within the transect the carbonate content has declined from 66% to 6·1%, owing to leaching and the accumulation of organic matter. The figures for the actual machair show a decline with its increased maturity from 58% to 38%.

In the dune zones the soil samples, which disintegrated on handling, were of greyish-white cement colour and contained few roots. In passing through the machair zones the colour of the samples changed from light to dark brown, and they became progressively firmer in texture until the marsh was reached, when they were almost black in colour with a spongy texture. Thus Table 6 shows a fairly steady increase in percentage loss on ignition on passing inland towards the more mature zones.

The two series of water content figures were estimated on different days, and show a parallel trend with the figures for loss on ignition, as might be expected. The effect of increase in the humus is better shown by the water capacity figures. Sample 17 appears to be an anomalous result, but the high figure can be explained by the fact that the sample was taken from the site of a former slack of the old dune system. Doubtless other samples taken from hollows would have shown the same result, but the corollary that former dune ridges should give low figures does not appear to hold.

The general trend in pH value (Table 6) is to show a decline which is directly proportional to the age of the machair, as the general topography of the landward machair indicates that it is older than the seaward. The range is not great, the machair proper varying between pH 6·8 and 7·8, while it is not possible to trace any correlation between the ridges and the hollows of the former dune system. General pH values for the island show a relatively small range. Callunetum at Barrapoll showed a pH of 6·2, while the lowest pH found in quite wide sampling was 6·1 from a meadow near Balinoe. Loch a'Phuil, which drains an extensive area of heath, had a pH of 7·5.

TABLE 6.

THE SOIL OF THE BALINOE MACHAIR.

(pH values, Calcium Carbonate, Loss on Ignition, Water Capacity, and Water Content.)

Sample Number		Distance from High Water* Feet	Height above Sea Level† Feet	pH			Ca CO$_3$ % Dry Wt.	Loss on Ignition % Dry Wt. (Corrected for Ca CO$_3$	Water Capacity (%)			Water Content (%)	
				Series 1	Series 2	Series 3			Series 1	Series 2	Series 3	Series 1	Series 2**
1	Dune Zones	0	6·5	8·2	7·5	7·7	—	—	—	—	—	—	—
2		25	8·9	—	—	—	66·0	2·12	31·3	—	38·5	6.52	—
3		100	22·6	8·1	7·5	7·5	56·8	3·48	40·8	38·8	57·7	9·33	10·7
4	Young Machair	200	30·3	7·8	7·7	7·4	58·0	4·36	68·6	45·0	83·6	14·5	11·4
5		300	30·5	7·8	7·5	7·5	—	—	—	—	—	—	—
6		400	30·8	7·5	7·7	7·5	56·6	11·52	—	69·6	52·8	—	—
7		500	34	7·1	7·5	7·4	—	—	—	—	—	—	19·3
8	Mature Machair	600	34·9	7·0	7·5	7·4	55·9	10·84	118.0	131·1	118·4	35·96	17·1
9		700	35·7	6·9	7·4	7·5	—	—	—	—	—	—	19·2
10		800	37·2	7·0	7·6	7·7	45·9	21·94	—	92·9	147·9	—	—
11		900	45·2	6·8	7·7	7·5	—	—	—	—	—	—	—
12	Old Machair	950	47	—	—	—	47·4	19·27	—	105·6	112·1	—	—
13		1000	38·6	6·8	7·5	7·4	—	—	—	—	—	—	—
14		1100	34	6·8	7·4	7·5	38·7	14·13	153·9	108·5	107·9	34·18	23·5
15	Transition Region	1200	34·3	6·6	7·5	7·5	—	—	—	—	—	—	—
16		1250	34·5	—	7·4	7·4	—	—	—	—	—	—	40·7
17		1300	35·1	7·0	7·3	7·3	8·9	37·8	—	—	444·4	—	—
18		1350	35·6	—	7·4	7·3	—	—	—	—	—	—	—
19		1400	36·6	7·0	7·3	7·3	14·3	32·02	298·1	129·0	190·6	45·22	46·2
20		1450	36·1	—	7·4	6·8	—	—	—	—	—	—	—
21	Marsh	1500	36·4	6·4	7·1	7·5	18·0	38·86	198·9	142·5	334·6	75·93	52·5
22		1600	35·2	6·8	7·1	7·2	6·1	70·7	399·9	487·5	—	83·8	—
23		1650	34·8	6·9	7·1	7·1	—	—	—	—	—	—	—

*Mean High Water Mark Ordinary Spring Tide.

†Assumed Mean Sea Level at Scarinish.

**J. M. Boyd's figures.

The surface soil of the machair is firm and very tightly compacted. Spot sampling of the surface root mat within the area of the transect showed that the great majority of the roots occurred in the top 4 cm., and few roots extended below 8 cm. in depth. When such a soil is brought under the plough it becomes very loose and liable to erosion, and is short of organic matter, despite the application of seaweed.

The arable land receives seaweed and a limited amount of artificial manures, but the machair receives nothing but the dung and urine of grazing animals. Boyd (1956) has figures showing 170 parts per million of available P_2O_5 in Tiree machair soils, and figures of the order of 590 parts per million for dune sands, but nevertheless many plants show the dull bluish green colour with purple tints, characteristic of phosphorus deficiency.

Biotic Factors: In the absence of grazing animals, the vegetation remains characteristic of fixed dune, being particularly noticeable at the N.E. end of the Balinoe machair where land has been enclosed by a fence. On the landward side of the fence is typical fixed dune, due entirely to the exclusion of cattle, while on the seaward side typical machair has formed. The development of machair is always most advanced in places adjacent to steadings, and which are consequently subjected to heavier grazing and manuring.

Cattle are responsible for by far the greatest amount of grazing on the machair, though there are sheep in most places. There is a large population of hares, but there have never been any rabbits on the island. In winter there are wild geese, which graze on the machair.

Each croft has a souming, but it is probable that the permitted number is exceeded. Therefore nearly all the machairs are badly over-grazed, that of Balinoe particularly so, with the result that the better grazing species are severely punished. Although the frequencies of *Lolium perenne, Poa pratensis* and *Cynosurus cristatus* are fairly high, their cover is negligible, and this may be directly attributed to the heavy grazing.

As a further result, *Senecio jacobaea* is widespread in many areas, and judging from the number of seedlings and young plants, appears to be still increasing. In the young machair at Balinoe it amounted to 12% of the cover, and in certain areas the figure is undoubtedly higher. Although in the mature machair the cover percentage is relatively low, there are many seedlings present. Similarly, the high frequency of *Euphrasia officinalis,* e.g. at Balephuil, may be attributed to the lack of competition from tall-growing species, as may also the high frequency of *Rhytidiadelphus squarrosus* in some areas.

It is noticeable that where plants receive protection from grazing, e.g. in fence bottoms or at the base of telegraph poles, the average height of plants is four or five times that of their counterparts in the open machair. Where machair has been enclosed for a few years and not subjected to grazing, as within the airport perimeter fence, there is a dense growth of tall herbage with *Festuca rubra* dominant.

The absence of *Ammophila arenaria* from the main area of Balinoe is possibly due to its inability to withstand heavy grazing. Where *Ammophila arenaria* and *Agropyron junceiforme* occur together in dunes, the *Ammophila* is eliminated much more readily than the *Agropyron,* which persists, even though feebly, well into the machair zone.

Direct human influence on the machair vegetation, except through the control of grazing of domestic animals, is small. In the past, the open machair will have been cultivated, and also fields enclosed from it, but this is not a present-day factor on Tiree. Cart tracks over the machair have caused damage in some places, particularly when the ruts get inconveniently deep, causing the carts to move over to a new track. It was not observed that this factor led to any direct blowing of sand, as reported by Fraser Darling (1947).

The blowing of sand is serious in some areas, notably at a'Croiss and Cornaigmore where the blowing can be directly related to the paucity of the flora, many seaward dunes having only *Ammophila arenaria.* A contributory factor is the unrestricted access of cattle and sheep to almost all dunes. Animals cause damage, apart from grazing much-needed cover, by trampling the surface of the dune, breaking it into large clods of turf which fall away leaving the sand exposed.

The machair footpaths and roadsides respond to treading in a fashion similar to that recorded by Davies (1938), and Bates (1935). Footpaths over the machair frequently have vegetation composed entirely of *Lolium perenne* and *Trifolium repens* with *Plantago major* in the most trodden parts.

DISCUSSION.

The term machair, as pointed out by Wilmott (1945), has been used indiscriminately to describe an association which has developed on dunes on one hand, and on the other where development has been on blown sand overlying peat or rock. Nevertheless, it seems on investigation that no case can be made for sub-dividing the association on the basis of origin of the underlying soil. A definition can be based on four criteria: (1) The machair is a semi-natural grassland; (2) it develops on calcareous shell sand; (3) its development is due to grazing; (4) the psammophilous dune grasses have been eliminated. The last criterion separates the machair from fixed dune.

The machair may be regarded as a biotic plagioclimax from which further succession, on cessation of grazing, would culminate on the west coast with either *Calluna* or *Molinia* heath. The preponderance of *Calluna* or *Molinia* will vary according to freedom of drainage. Callunetum has been described as the culmination of succession for non-calcareous dune systems in North Lancashire (Pearsall, 1934) and Dorset (Good, 1935), and it will be noted that the species list for heath on shell sand at Traigh Balbhaig, pH circa 6·2, closely resembles that of typical heather moor of Smith (1900). Tiree being intensively cultivated, it is difficult to find perfect examples of the complete succession to heath, but Traigh Balbhaig gives a clear indication that this can occur.

The botanical composition of the machair closely resembles that of dune pasture and fixed dune recorded for a number of calcareous stations, e.g. Tramore, Donegal (Tansley, 1939), Barra (MacLeod, 1948), Luskentyre, Outer Hebrides (Gimingham *et al.*, 1948) and Dog's Bay, Galway (Tansley, 1939). There are, however, a number of differences, in particular the presence and high frequency of *Lolium perenne, Poa trivialis* and *Cynosurus cristatus,* all species normally absent from such a habitat. The machair is a grass-legume association bearing a strong resemblance to the chalk grasslands of Southern England, except that *Festuca ovina* is replaced by *Festuca rubra.* The number of machair species is thirty-eight, which is somewhat higher than has been generally recorded for other calcareous dune pastures, but falls far short of the ninety-two recorded by Gimingham (1951) for a dune pasture at St. Cyrus, Kincardineshire, which though not calcareous has basic influence from cliffs. A study of the lists of machair and dune species shows that few are markedly calcicolous. Of the seventy species given by Salisbury (1952) as being plants of dunes commonly associated with calcareous soils, only seven are represented in the Tiree lists. Of these only *Koeleria gracilis* can be regarded as an obligate calcicole. Nevertheless, comparison with the non-calcareous fixed dunes of Blakeney Point (Oliver and Salisbury, 1913) shows that only four species are common to the lists of both stations, and the absence of basifuge plants from the Tiree lists is marked.

It should be noted that although the dominant species of the Tiree machair is *Festuca rubra* there is evidence (Fraser Darling, 1955) that machair elsewhere may have *Festuca ovina* or *Agrostis stolonifera* as the dominant.

The edaphic data accorded with previous work (Salisbury, 1922, 1925) on dune soils. A feature is the high retentive capacity of even the younger soils, this being in part due to the unusually high organic content for dune soils, resulting from the heavy grazing. The comparatively small grain size of the shell sand and the consequently increased ratio of the total surface of the grains/volume of the sand, coupled with the natural porosity of the material, further increases the retentiveness. A comparison with data given for Comporta (Oliver, 1926), Southport (Pearsall, 1934), and Blakeney (Salisbury, 1922), shows that Tiree sand contains the highest proportion of small diameter grains. This tends to conflict with the evidence that the average size of sand that forms any dune is related to the strength of the onshore winds, being largest in size with the greatest winds. Probably this is because the shell sand disintegrates more readily than sand of siliceous origin.

The signs of apparent phosphorus deficiency, despite the high phosphate content of shell sand, may be due to the reduced capacity of plants to take up phosphorus at high pH, as only the monovalent ion H_2PO_4 is available (Van den Honert, 1933; Olsen, 1953). A contributory factor may be the exhaustion of available P_2O_5 from the top 4 cm. of the soil, beyond which depth in the machair few roots extend.

Figure 2 shows the cover percentage, expressed as a percentage of the maximum of the seven characteristic machair species, in relation to calcium carbonate and water capacity. Of the seven

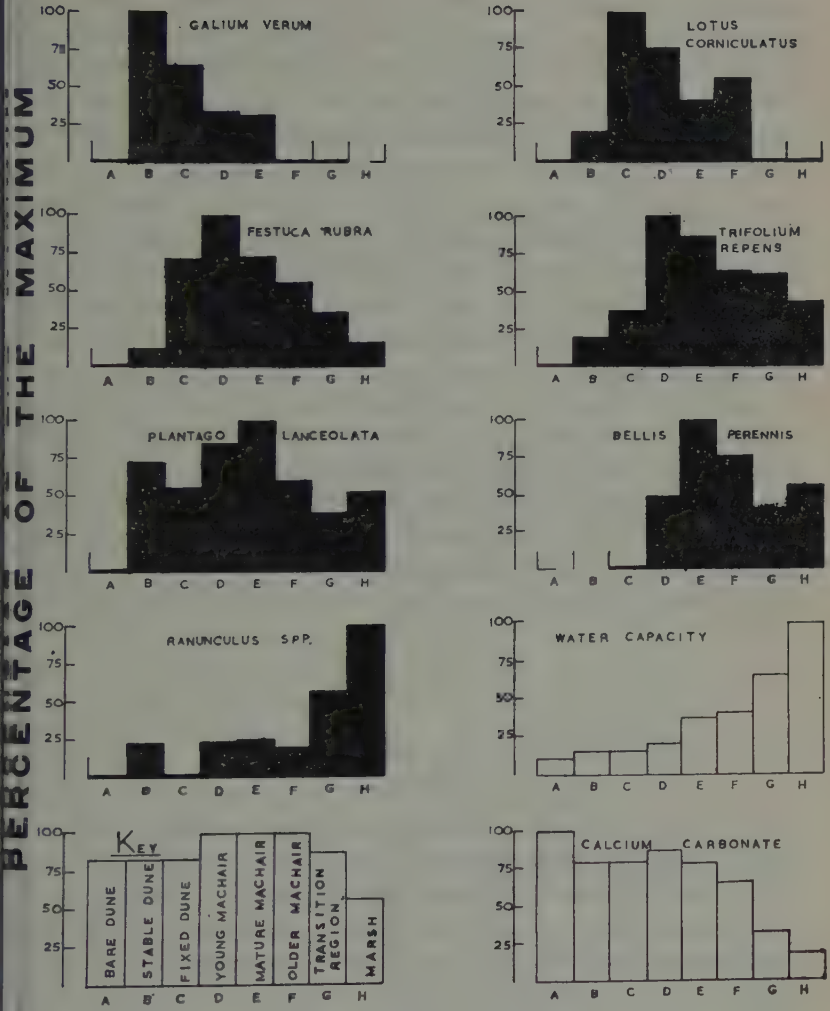

Fig. 2.

Cover percentage, expressed as a percentage of the maximum, of the seven characteristic machair species, in relation to calcium carbonate and water capacity.

species none is an obligate calcicole and, with the possible exception of *Trifolium repens* and *Plantago lanceolata,* all are found on non-calcareous dune soils. Considering that the variation in pH over the whole transect ranges only between 7·2 and 8 on average, it seems probable that the distribution of the characteristic species is governed by the organic content of the soil and its effect on the available moisture. Changes in calcium carbonate status appear to be of secondary importance.

It seems clear from the botanical analysis and from observations of lightly-grazed areas that the machair could be more productive. At present grazing is hard and continuous for most of the year, except on the Reef which is rested in summer, but nevertheless the better grazing species such as perennial ryegrass, the meadow grasses, wild white and wild red clovers are present in quite high frequency. Some form of periodic grazing coupled with even light dressings of a complete fertilizer would do much to encourage productivity. The communal purchase by a township of an electric fence would be well repaid, as one of the difficulties of proper management is the lack of fencing, though Tiree is better off than some machair land in this respect. None of the Tiree arable is unfenced as is the case in the Outer Isles (Kerr, 1954).

SUMMARY.

The Tiree machair is a Festucetum rubrae which develops as a biotic plagioclimax on calcareous shell sand. The distribution of the species within the machair is apparently dependent more on the water capacity of the soil than on variation in its calcium carbonate content or pH. The climax vegetation, if grazing ceased, would be *Calluna* or *Molinia* heath. Features of the machair soils are their relatively high retentive capacity compared with stable dune soils elsewhere, and their high pH. Species lists for machair and dunes are of similar length to those for siliceous dunes and pastures. Although basifuge species are absent there are very few obligate calcicoles. It is suggested that the productivity of the machair could be greatly increased by rotational grazing, coupled with dressings of a complete fertilizer.

ACKNOWLEDGMENTS.

We take pleasure in thanking the many people who have contributed to the completion of this work, which is based on observations made on Tiree in July 1952. We are indebted in particular to Professor J. Walton for his encouragement, to Miss A. C. Kennedy, Balinoe, Tiree, for her invaluable co-operation, to our colleague J. M. Boyd for valuable discussions and use of data from his work on the machair fauna, and to J. T. Forrest and J. T. MacConnell for help with some of the botanical analysis. To Dr. E. Conway and Mr. A. R. Beddows we are grateful for helpful criticism of the manuscript in its various stages.

REFERENCES.

BATES, G. H. (1935). The Vegetation of Footpaths, Sidewalks, Cart-Tracks and Gateways. *J. Ecol.*, **23**, 470.

BOYD, J. M. (1956). *Personal Communication.*

DARLING, FRASER F. (1947). *Natural History of the Highlands and Islands.* Collins, Glasgow.

DARLING, FRASER F. (1955). *West Highland Survey.* Oxford University Press.

DAVIES, W. (1938). Vegetation of Grass Verges and other excessively Trodden Habitats. *J. Ecol.*, **26**, 38.

GIMINGHAM, C. H., GEMMELL, A. R., and GREIG-SMITH, P. (1948). The Vegetation of a Sand Dune in the Outer Hebrides. *Trans. Bot. Soc. Edinb.*, **35**, 82.

GIMINGHAM, C. H. (1951). Contributions to the Maritime Ecology of St. Cyrus, Kincardineshire. Part II. The Sand Dunes. *Trans. Bot. Soc. Edinb.*, **35**, 387.

GOOD, R. (1935). Contributions toward a Survey of the Plants and Animals of the South Haven Peninsula, Studland Heath, Dorset. II. General Ecology of the Flowering Plants and Ferns. *J. Ecol.*, **23**, 361.

HARRISON, J. W. H. *et al.*, (1939). The Flora of the Isles of Coll, Tiree and Gunna (v.c. 110b). *Proc. Univ. Dur. Phil. Soc.*, **10**, Part 4.

HONERT, T. H. VAN DEN (1953). Phosphate Absorption by Sugar Cane. *Verslag 13e Vergadering Vereeniging Proefstations Personeel.*

JEFFERIES, T. A. (1915). Ecology of the Purple Heath Grass (*Molinia caerulea*). *J. Ecol.*, **3**, 93.

KERR, D. H. (1954). Machair Land in the Outer Isles. *Scottish Agriculture*, **34**.

MACLEOD, A. M. (1948). Some Aspects of the Plant Ecology of the Island of Barra. *Trans. Bot. Soc. Edinb.*, **35**, 67.

MACVICAR, S. M. (1898). *Ann. Scot. Nat. Hist.*, 31-38, 81-97.

Meteorological Office, London (1920-4). *The Book of Normals of Meteorological Elements for the British Isles for Periods ending 1915.*

(1952). *Climatological Atlas of the British Isles.* H.M.S.O.

Oliver, F. W., and Salisbury, E. J. (1913). Topography and Vegetation of Blakeney Point. *Trans. Norfolk and Norwich Nat. Soc.*, **9**.

Oliver, F. W. (1926). A Portuguese Sand Dune. *Trans. Norfolk and Norwich Nat. Soc.*, **12**, 279.

Olsen, C. (1953). The Significance of Concentration for the Rate of Ion Absorption by Higher Plants in Water Culture. *Physiol. Plant.*, **6**, 837.

Ordnance Survey (1926). *Geological Survey of Scotland, Tiree*, Sheets 42 and 50 (1 in. to 1 mile).

Pearsall, W. H. (1934). Lancashire Sand Dunes. *Naturalist*, 201.

Salisbury, E. J. (1922). The Soils of Blakeney Point: a Study of Soil Reaction and Succession. *Ann. Bot. Lond.*, **37**, 391.

Salisbury, E. J. (1925). Notes on the Edaphic Succession in some Soils with Especial Reference to the Time Factor. *J. Ecol.*, **13**, 322.

Salisbury, E. J. (1952). *Downs and Dunes, their Plant Life and its Environment.* Bell, London.

Smith, R. (1900). *Scot. Geog. Mag.*, **16**, 455.

Smith, W. G., Moss, C. E., and Rankin, W. M. (1903). *Geog. J.*, **22**.

Tansley, A. G. (1939). *The British Isles and their Vegetation.* Cambridge University Press.

Wilmott, A. J. (1945). Ch. 3. Vegetation, *in* M. S. Campbell, *The Flora of Uig.* Arbroath.

ADDITIONS TO THE FLORA OF EIGG (V.C. 104).

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(Read by title, 14th June 1956.)

During a wet week spent in splashing about the island of Eigg in the summer of 1954, a few plants were collected that have not been previously recorded from the island by S. M. Macvicar (1897), J. W. Heslop Harrison (1939) or D. H. N. Spence (1952). In addition to novelties, a few species are included here whose previous records seem to need confirmation.

I am indebted to Mr. E. Nelmes, Mr. C. E. Hubbard and Mr. D. M. Henderson for the identification of *Carex,* Gramineae and *Chara* respectively. The specimens are deposited in the herbarium of the Royal Botanic Garden, Edinburgh.

AGRIMONIA ODORATA (Gouan) Miller

Laig Bay, 5 m., on grassy slopes over oolite, rare, 29.6.1955, D.701/GB: 1955. Observed near Kildonan in hazel woods.

Although recorded for the island by Heslop Harrison, the additional localities seem worth noting, since Warburg (in Clapham, Tutin & Warburg, 1952) gives the British distribution of the species as "from Kintyre and Kincardine southwards"—a range which does not include the Inner Hebrides. This may well be the plant recorded as *A. eupatoria* by Macvicar.

ALCHEMILLA GLABRA Neygenfind

Laig Bay, 5 m., damp grassy slope on oolite, 29.6.1955, D.747/GB: 1955.

Heslop Harrison only records *A. minor* Hudson from Eigg, but Macvicar cites both *A. glabra* (as *A. alpestris*) and *A. xanthochlora* Rothm. (as *A. pratensis*)—determined for him by E. F. Linton.

NASTURTIUM OFFICINALE R. Br. sens. str.

Laig Bay, 5 m., in stream, 29.6.1955, D.660/GB: 1955.

The diploid Watercress is presumably the species referred to under the aggregate name *N. officinale* by Heslop Harrison.

SHERARDIA ARVENSIS L.

Between Kildonan and Poll nam Partam, 10 m., field weed (*Holcus lanatus* dominant), 25.6.1955, D.794/GB: 1955.

New for Eigg. Heslop Harrison records the species only from Canna.

MELAMPYRUM PRATENSE L. var. MONTANUM Johnston, Fl. Berwick, i, 136 (1829).

Poll nam Partam, 20 m., at edge of hazel scrub, with *Calluna* and *Anthoxanthum odoratum,* rare, flowers sulphur yellow, 25.6.1955, D.701A/GB: 1955.

The species has not previously been recorded from Eigg.

UTRICULARIA INTERMEDIA Hayne

North of Sgurr, 300 m., in peat lochan in 6 in. of water, 30.6.1955, D.739/GB: 1955 (sterile).

New for Eigg. Spence records *U. minor* from the island.

PLATANTHERA CHLORANTHA (Cust.) Rchb.

Laig Bay, 5 m., in pasture on oolite, 29.6.1955, D.668/GB: 1955. Poll nam Partam, 5 m., on grassy slope (*Anthoxanthum odoratum,* etc.) with *Gymnadenia conopsea,* 25.6.1955, D.674/GB: 1955. Observed at Cleadale and Kildonan.

Heslop Harrison only records *P. bifolia* Reich. fil. which I could not find.

CAREX DISTANS L.

Laig Bay, in salty turf near the sea with *Festuca rubra* and *Carex* spp., 2.7.1955, D.696/GB: 1955; *ibid.,* in damp places by shore, tufted, 29.6.1955, D.704/GB: 1955.

New for Eigg, and recorded by Heslop Harrison only from the Hyskeir reef.

BROMUS MOLLIS L., sen. str.

Cleadale, 30 m., in a clump of *Urtica dioica* near cottages, 29.6.1955, D.716/GB: 1955—probably a recent introduction.

Bromus thominii Hard.

Above Poll nam Partam, 20 m., quite common in field with *Holcus lanatus*, etc., 25.6.1955, D.795/GB: 1955. Hubbard's annotation reads: "luxuriant plant, but note large anthers c. 1·5-2·0 mm."

Macvicar only records '*B. mollis*' from Eigg and Heslop Harrison '*B. hordeaceus*'—both may well refer to *B. thominii*.

Agropyron junceiforme (A. & D. Löve) A. & D. Löve × A. repens (L.) Beauv.

Laig Bay, at back of shingle shore, 29.6.1955, D.707/GB: 1955

Macvicar records both parents from the same locality. This hybrid is probably the plant identified by him as '*A. acutum* R. & S.?' (*A. repens* × *A. pungens*—a species that does not occur in Scotland).

Chara delicatula Ag.

North of the Sgurr, 300 m., in peat lochan with *Utricularia intermedia* in 6 in. of water, 30.6.1955, D.740/GB: 1955.

New for Eigg.

References.

Clapham, A. R., Tutin, T. G. & Warburg, E. F. (1952). *Flora of the British Isles.* Cambridge University Press.

Harrison, J. W. Heslop (1939). The Flora of the Islands of Rhum, Eigg, Canna, Sanday, Muck, Eilean nan Each, Hyskeir, Soay and Pabay. *Proc. Univ. Durham Phil. Soc.*, **10**, 87.

Macvicar, S. M. (1897). On the Flora of Eigg. *Ann. Scot. Nat. Hist.*, **34**, 110.

Spence, D. H. N. (1952). Flora of Eigg: Additions and Notes. *Trans. Bot. Soc. Edinb.*, **36**, 74.

NOTES ON FRESHWATER ALGAE, MAINLY FROM LOCHS IN PERTHSHIRE AND SUTHERLAND.

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(Brown Trout Research Laboratory, Pitlochry).

(Read by title, 14th June 1956.)

As in the case of two earlier notes on Scottish freshwater algae (Brook, 1954, 1955), all the species discussed in the present communication either are of rare occurrence, or are new records for Scotland and, in some cases, for the British Isles. The locality of each loch mentioned is indicated by the full National Grid Reference, given after it is named in the text for the first time.

The author wishes to express his thanks to Dr. H. D. Slack of the University of Glasgow who collected many of the samples containing interesting material; also to several of his colleagues who have sampled lochs in Sutherland.

ISOKONTAE.

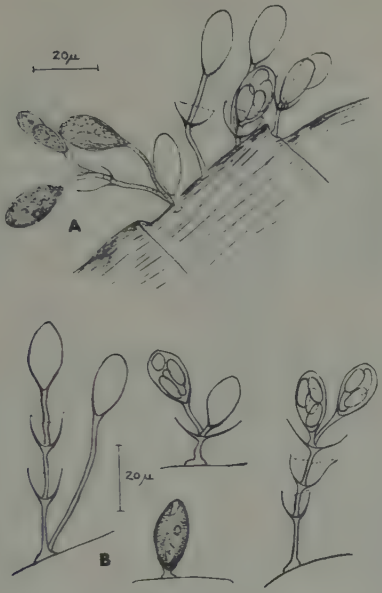
VOLVOCALES.

1. CHARACIOCHLORIS EPIZOOTICA (Korschik.) Pascher (Text-fig. 1).

Pascher (1927), p. 486-7, and fig. 442. Skuja (1948), p. 104, Pl. 8, figs. 22-27.

Present on occasional individuals of *Diaptomus gracilis* in summer in Loch Choin, North Perthshire (27/688679) and on others from Loch Chon, near Aberfoyle, S.W. Perthshire (27/420050).

This alga grew abundantly on *Diaptomus* in laboratory cultures from material collected from Loch Choin, and its identity was kindly confirmed from this material by Prof. H. Skuja who considered it to be the most luxuriant development of this organism that he had seen. In this material, and in that from Loch Chon, Aberfoyle, there was a marked tendency for new individuals to remain and develop within the cup-shaped lower half of the old, empty mother cells. Two or even three of the tetrad of daughter cells which arise from each mother cell may develop in this position (Text-fig 1, A). In addition a succession of individuals may arise within these old cups, the remains of four generations, one within the other, often being present. (Text-fig. 1, B.)



TEXT-FIG. 1.

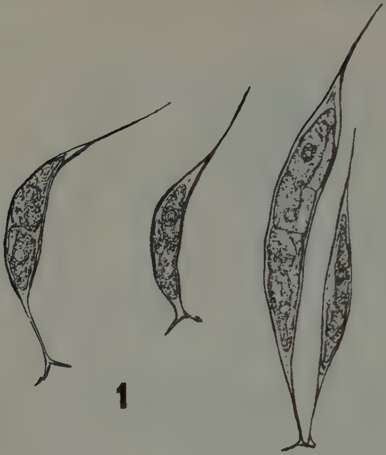
1. CHARACIOCHLORIS EPIZOOTICA (Korschik.) Pascher.
   - A. Group of individuals on *Diaptomus gracilis* from Loch Chon, Aberfoyle, showing development of new cells within remains of old mother cells.
   - B. Specimens from Loch Choin, N. Perthshire, showing development of successive generations within mother cell remains.

The cells range from 4 to 12·5 μ br. and from 7 to 25 μ l. Their mucilage stalks may be as long as 50 μ, though usually they are much shorter (15-25 μ l.).

CHLOROCOCCALES.

1. **CHARACIUM GRACILIPES** Lambert (Text-fig. 2, 1).

A frequent epiplankter on *Daphnia hyalina* from Loch Laggan, near Fintry (26/625925) and Lochan Geal, to the north of Loch Lomond (27/318163), with *Colacium vesiculosum* Ehrb. It has been observed that while the base of most of the cells is attenuated to form a long, slender, filiform stipe with a typically branched end which serves for attachment, the stipe may sometimes be absent, the branched base developing directly from the body of the cell. Cells 50-75 μ l., 5-8 μ br.



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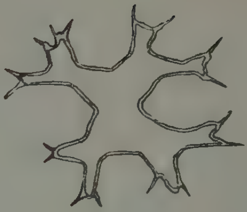

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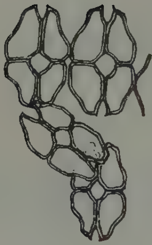

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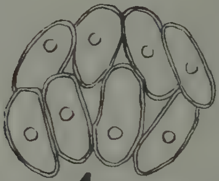

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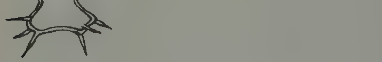

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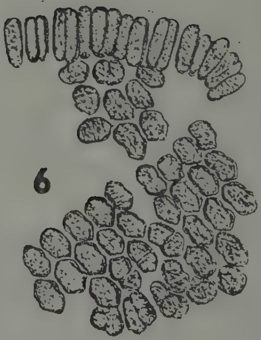

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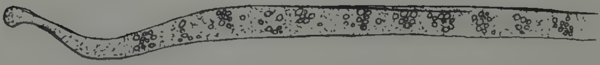

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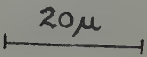


2 **Tetraedron gracile** (Reinsch) Hansgirg (Text-fig. 2, 2). (See Smith (1920), p. 122, Pl. 26, figs. 1-5.)

Rather stouter and more angular specimens of this alga than those hitherto described were present in small numbers in the summer plankton of Loch Shurrery, Caithness (39/044555). Nevertheless, the twice-branched angles of the cells, producing the narrowing processes which end in minute spines, and the fact that the primary branchings are at an angle of 90° with one another and parallel with the sides of the cells, confirms the identity of this alga.

3. **Closteriopsis longissima** var. **tropica** W. & G. S. West.

Present in the summer plankton of Loch na Beiste Brice, Sutherland (29/238501). Cells mostly 90-100 μ l. and 5 μ br. tapering to 2 μ at the ends, each with a single chloroplast containing 5 or 6 pyrenoids. Since it was first described from the Shetlands (W. & G. S. West, 1905) it is believed that this alga has not been recorded from elsewhere in the British Isles.

4. **Crucigenia pulloideum** (Teiling) nov. comb. (Text-fig. 2, 3). (=*Tetrastrum pulloideum* Teiling, Bot. Notiser, 1942, p. 66, fig. 2.)

Cells quadrately arranged, with groups adhering to form syncoenobia consisting usually of 16, or more rarely, 24 cells. Bases and middle third of the inner sides of each cell in mutual contact and in consequence flattened. Apices of cells tapering to minute points (apiculi) which in the present material would seem to be more delicate than those depicted by Teiling (1942). Adjacent apiculi pointing inwards, towards one another as in *Crucigenia apiculata* Schmidle, though differing from this species in that the outer cell faces are markedly concave, thus resembling *Crucigenia crucifera* (Wille) Collins and *C. truncata* Smith. Cells 4-8 μ l., 3-6 μ br. Coenobia 9-16 μ l., 6-12 μ br.

Text-fig. 2.

1. **Characium gracilipes** Lambert.
2. **Tetraedron gracile** (Reinsch) Hansgirg.
3. **Crucigenia pulloideum** (Teiling) nov. comb.
4. **Scenedesmus arcuatus** Lemm.
5. **Isthmochloron trispinatum** (West & West) Skuja.
6. **Holopedia geminata** Lagerh.
7. **Oscillatoria splendida** Grev. forma.

Since these plants show clear affinities with the abovementioned *Crucigenia* species and in addition regularly form syncoenobia, it seems reasonable to transfer this species from the genus *Tetrastrum* to *Crucigenia*.

Rare with *Crucigenia minima* Brunn. in the summer plankton of Loch an Daimh Beg, Sutherland (29/163428).

5. Crucigenia tetrapedia (Kirchn.) W. & G. S. West.

Occasional in the plankton of Lochan Spling, Perthshire (27/503004). The square coenobia were mostly 8 μ br.

6. Scenedesmus arcuatus Lemm. (Text-fig. 2, 4.)

Frequent in the plankton of Littleton and Waulkmill Reservoirs (26/524579), Renfrewshire. Curved coenobia consisting of 8 cells 10-18 μ l., 4-7·5 μ br., alternately arranged in a double row. Cells somewhat flattened where they join one another, and with small, though distinctive intercellular spaces between each. Coenobia 20-28 μ br., 22-35 μ l.

HETEROKONTAE.

1. Isthmochloron trispinatum (West & West) Skuja (Text-fig. 2, 5). (=*Arthrodesmus trispinatus* West & West.)

Occasional in the spring plankton of Loch an Daimh Mor, Sutherland (29/159432). This alga was originally described from N. Ireland by W. & G. S. West (1902) and named *Arthrodesmus trispinatus*. (It is also figured from African material by Fritsch and Rich, 1937, p. 203, and Fig. 20B). Since the Wests' description was based on fixed material which did not allow the exact nature of the chloroplasts to be determined, they conceded that the alga might, however, be one of the Chlorococcales belonging to the genus *Tetraedron* rather than a desmid. It was in fact renamed later *Tetraedron trispinatum* by Huber-Pestalozzi (1938) (see also Teiling, 1946, fig. 7). However, Skuja's recent critical study (1948) of this plant indicates that it should in fact be regarded as a heterokont. In agreement with Skuja's description the corners of these tetrahedral cells may be tipped with a very variable number of spines which in the Sutherland plants may be from 2 to 5. (Skuja, Pl. XXXVI, figs. 9-11, indicates 6 in some cases.) Moreover, these spines do not all lie in the same plane.

CHRYSOPHYCEAE.

1. **MALLOMONAS ELONGATA** Reverdin.

Rare in the plankton in the southern basin of Loch Lomond (26/390890). Cells mostly 75-80 μ l., 17·5 μ br. It is believed that this alga has not previously been recorded in Britain.

2. **HYALOBRYON POLYMORPHUM** Lund.

This chrysophycean was first described by Lund (1953) as an epiplankter on the cells of various planktonic algae from several of the English Lakes. It has now been observed with *Salpingoeca frequentissima* (Zach.) Lemm. on *Asterionella formosa* Hass.; also on *Eucapsa alpina* Clem. & Shantz and on *Gemellicystis neglecta* Teiling em. Skuja, from Loch Kinardochy, Perthshire (27/775550). The latter alga also carried *Salpingoeca* and some individuals were at the same time parasitized by the chytrid *Rhizophydium fulgens* Canter. Lund (private communication) has suggested that the alga referred to as *Hyalobryon mucicola* Pascher (Brook, 1954, p. 209, Fig. 1, 5) and which was present in considerable numbers on glass slides which had been submerged in this loch, is also *H. polymorphum*.

Dinobryon tabellariae (Lemm.) Pascher has been found in small numbers on *Asterionella formosa* from Loch Freuchie, Perthshire (27/865375).

BACILLARIOPHYCEAE.

1. **MELOSIRA GRANULATA var. ANGUSTISSIMA** O. F. Müll.

Very abundant in the highly eutrophic Lindores Loch (Fife) (37/265165) (in May, pH 8·7, alkalinity 70 p.p.m. $CaCo_3$, total hardness 99) in July, with a bloom of *Anabaena planctonica* Brunn. and persisting until September. The identity of this alga has been kindly confirmed by Dr. J. W. G. Lund. Lund (1954) has pointed out that *Melosira granulata* is widespread in lakes and reservoirs in the lowlands of England but is absent from lakes and tarns in the English Lake District. There would appear to be no authentic records of this diatom for Scotland for although the Wests listed it from Loch Lomond, Lund's re-examination of their material has shown it to be in fact *M. italica subarctica*. During the past year a considerable number of plankton samples from Loch Lomond have been examined by the author and once again only the latter species has been encountered.

2. **Cyclotella glomerata** Bachmann

Lund (1951) has recorded this diatom from the plankton of 19 bodies of freshwater in the English Lake District, and it has also been recently recorded from Wales by Woodhead and Tweed (1954a). Small groups of this very small diatom, usually consisting of not more than 4 cells, have now been found in Sutherland in Loch a' Bhadaidh Darraich (29/167445), Loch Borralich (27/382670) and Loch an Daimh Beg; in Inverness in Loch Morlich (28/965095) and Loch Pityoulish (28/920135); from Loch Leven, Kinross (37/145020); and in Perthshire from Loch Bhac (27/822622), Loch Kinardochy, Loch na Craig (27/883455), Loch of Craiglush (37/043443), Loch Kennard (27/905460), Loch of Lowes (37/050440), and Loch Skiach (27/950475).

Maxima in early May, 1956, of 7880 and 1380 cells per ml. have been recorded from Loch Kinardochy and Loch Skiach respectively. The average colony size of these populations was approximately four cells, and the largest was eighteen cells.

CYANOPHYCEAE.

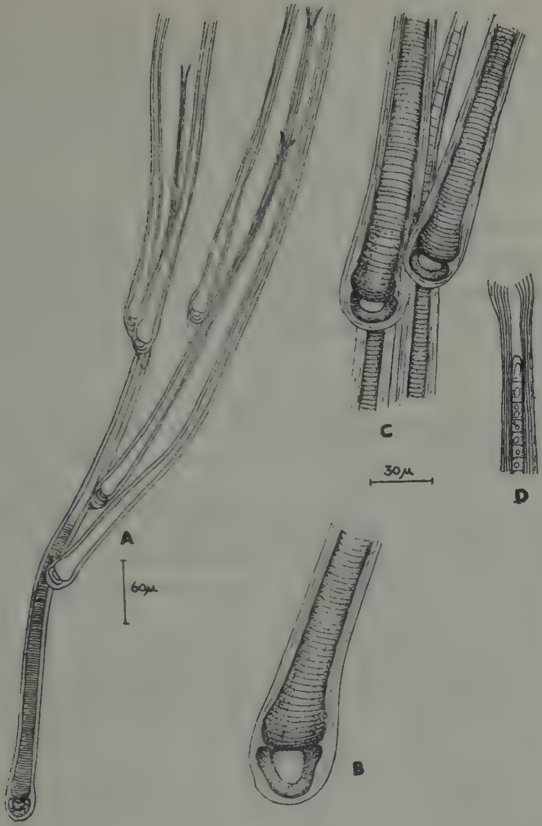
1. **Holopedia geminata** Lagerh. (Text-fig. 2, 6.)

Rare amongst a bloom of *Oscillatoria limosa* Ag. in the eutrophic Auchterarder House Loch, Perthshire (27/958150) (pH 8·2, alkalinity 108). Colonies in the form of curved plates of more than 100 μ diameter. Cells 5 μ br. and 8-9 μ l.; mostly angular in surface view where mutually adpressed.

2. **Dichothrix baueriana** var. **crassa** Godward (Text-fig. 3).

This variety of *D. baueriana* was first described from Windermere (Godward, 1937, p. 562, fig. 21 A-E) and it would appear to have been recorded from no other part of Britain. Recently, however, considerable amounts have been found attached to various substrata in Loch an Daimh Mor, Sutherland. On occasions considerable amounts appear to have become detached, for well developed plants have been quite frequent in plankton samples.

The trichomes of the alga, which are for the most part about 15 μ br. tapering to 5 μ at their tips and swelling to 25-29 μ in breadth at their base, are enclosed in a firm, thick and distinctly stratified mucilage sheath, usually about 5 μ br. The sheaths are brown in colour in the basal region, becoming yellow towards



TEXT-FIG. 3.

1. DICHOTHRIX BAUERIANA var. CRASSA Godward.
   A. Detached plant from a plankton sample.
   B. Lowest (oldest) filament of a plant showing a typical cup-shaped heterocyst.
   C. Typical younger filaments with bean-shaped heterocysts.
   D. Tip of filament with narrowed, vacuolated trichome and showing separation of layers of the sheath.

the tips. The considerably narrower vacuolated cells in the tip of the trichome are up to 8 μ l., and in this region the layers of the enclosing sheath tend to separate, becoming markedly flared out at the end of each filament. The heterocysts tend to be broader than in the Windermere plants, being 22-25 μ br. and 15 μ l. in the older parts. However, in agreement with Godward's description they are mostly distinctly bean-shaped, except sometimes for the very oldest (lowest) heterocyst which may be cup- or dome-shaped, and slightly longer than broad (see Fig. 3A). In most heterocysts, the thick outer layer is of a vivid blue while the inner part is blue-grey in colour. The very swollen mucilaginous bases of the branches as described by Godward are not so conspicuous in the Sutherland material.

3. OSCILLATORIA SPLENDIDA Grev. forma (Text-fig. 2, 7).

The normal breadth of the cells of this alga is from 2-3 μ. A form however has been observed from Auchterarder House Loch, Perthshire, in which the trichomes were 5 μ br. and 6-8 μ l.

REFERENCES.

BROOK, A. J. (1954). Notes on some Uncommon Algae from Lochs in the Tummel-Garry Catchment Area. *Trans. Bot. Soc. Edinb.*, **36**, 207.

BROOK, A. J. (1955). Notes on some Uncommon Algae from Lochs in Kinross, Perthshire and Caithness. *Ibid.*, **36**, 309.

FRITSCH, F. E. & RICH, F. (1937). Contributions to Our Knowledge of the Freshwater Algae of Africa, 13. Algae from Belfast Pan, Transvaal. *Trans. Roy. Soc. S. Afr.*, **25**, 153.

GODWARD, M. B. (1937). An Ecological and Taxonomic Investigation of the Littoral Algal Flora of Lake Windermere. *J. Ecol.*, **25**, 496.

HUBER-PESTALOZZI, H. (1928). Beiträge zur Kenntnis der Süsswasseralgen von Korsika. *Arch. Hydrobiol.* (Plankt.), **19**, 669.

LUND, J. W. G. (1951). Contributions to Our Knowledge of British Algae. *Hydrobiologia,* **3**, 93.

LUND, J. W. G. (1953). New or rare British Chrysophyceae II. *New Phytol.*, **52**, 114.

LUND, J. W. G. (1954). The Seasonal Cycle of the Planktonic Diatom *Melosira italica subarctica. J. Ecol.*, **42**, 151.

PASCHER, A. (1927). *Die Süsswasserflora Deutschlands, Oesterreichs und der Schweiz.* Part 4, Volvocales.

SKUJA, H. (1948). Taxonomie des Phytoplanktons einiges Seen in Uppland, Schweden. *Symb. bot. Upsaliens.*, **9**, (3), 397 pp.

SMITH, G. M. (1920). Phytoplankton of the Inland Lakes of Wisconsin, Part I. *Wisc. Geol. & Nat. Hist. Surv.*, Bull., 57.

TEILING, E. (1942). Schwedische Planktonalgen 3. Neue oder wenig beKannte Formen. *Bot. Notiser*, 1942, 63.

TEILING, E. (1946). Zür phytoplanktonflora Schwedens. *Bot. Notiser*, 1946, (1), 61.

West, W. & G. S. (1902). A Contribution to the Freshwater Algae of the North of Ireland. *Trans. Roy. Irish Acad.*, **32**, 1.

West, W. & G. S. (1905). Freshwater Algae from the Orkneys and Shetlands. *Trans. Bot. Soc. Edinb.*, **23**, 3.

WOODHEAD, N. & TWEED, R. D. (1954). Freshwater algae from Anglesey and Caernarvonshire. *Northw. Nat.*, **2**, 85.

SNOW MOULD ON UPLAND PASTURE IN NORTH SCOTLAND.

By ELIZABETH G. GRAY and I. A. NICHOLSON*
(North of Scotland College of Agriculture, Aberdeen).

(Read by title, 17th January 1957.)

Snow mould, caused by the fungus *Fusarium nivale* Auct., "the commonest turf disease in Britain" (Sampson and Western, 1954), is to be found in North Scotland at any season of the year, whenever conditions become cool and moist. *F. nivale* also occurs on seed oats grown in the north and causes rotting of the seedling roots and stem (Noble and Montgomerie, 1954) Bennett (1933) reported a failure of perennial ryegrass (*Lolium perenne*) in a seeds mixture on a Cumberland farm in 1929, associated with *Fusarium nivale* and other species of *Fusarium*. Snow mould has not, however, been regarded as an important disease of pasture grasses in Britain, although there are many records of it from comparable areas in the north temperate zone.

In North-West America, *F. nivale* causes damage to winter wheat and to many species of grasses, killing some and checking the growth of others (Sprague, 1950). It has been studied especially in the Scandinavian countries where it is one of the principal winter-killing diseases of grass and cereals (Ekstrand, 1955). Susceptibility to snow mould is an important factor in determining where winter cereals can be grown in Sweden and Finland (Ekstrand, 1947 a, b; Jamalainen, 1955).

Of the grasses, timothy (*Phleum pratense*) shows great differences in varietal susceptibility in Sweden (Ekstrand, 1947 a). It gives a reliable crop in Finland and the Swedish variety Bothnia has been found resistant in Sweden and Finland. Meadow foxtail (*Alopecurus pratensis*), red fescue (*Festuca rubra*) and the meadow-grasses (*Poa* spp.) are regarded as resistant; meadow fescue (*F. pratensis*) is fairly resistant and cocksfoot (*Dactylis glomerata*) is rather susceptible. Most strains of the ryegrasses (*Lolium perenne* and *L. multiflorum*) are destroyed by snow mould, except Valinge perennial ryegrass which is considered well suited to Finnish conditions (Jamalainen, 1951, 1954).

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OCCURRENCE IN NORTH SCOTLAND.

In April and May 1955, *F. nivale* was identified on rotting leaves of *Agrostis* spp., *Lolium perenne* and *Poa trivialis* from various localities at Glensaugh, Kincardineshire, where dying-out had occurred. The fungus was found on two hill sites where re-seeding had taken place and on one "in-bye" grass field where *L. perenne* was the dominant species.

Site 1. The area lies at 1,000 ft., and the soil is podsolised with a thin layer of undecomposed humus overlying thin schist drift. Before burning in 1950, *Calluna vulgaris* was dominant. In 1952, owing to slow regeneration, several acres were disced, harrowed and surface-seeded to provide additional grazing. The soil was deficient in potash and phosphorus, especially the latter, and the pH was 4·4.* A part of the area was sown with different grass strains on small plots for comparative purposes. It was on these plots that observations on snow mould were made.

Dying-out in small circular patches was first noted on South German creeping bent (Mixture of *A. tenuis* and *A. stolonifera*) in summer 1954. In the following spring the diseased patches expanded greatly (Plate I, 1) and *Lolium perenne* (N.Z. mother seed) (Plate I, 2) and *Poa trivialis* (Plate I, 3) were also severely attacked. *Dactylis glomerata* (S.37†), *Phleum pratense* (S.51), *Festuca pratensis* (S.215), *F. rubra* (S.59), *Alopecurus pratensis* (Plate I, 4) and *Cynosurus cristatus* showed no sign of fungal attack, although spores of *Fusarium nivale* were identified on *F. rubra*. In 1956 there was still no sign of infection in these species, although the affected areas in the susceptible swards had greatly expanded and few plants remained of *L. perenne*.

Site 2. *Calluna vulgaris* was dominant on this area before ploughing in 1954. It lies at 650 ft. on Old Red Sandstone drift with a pH originally of 4·5.** Seeding took place in July when

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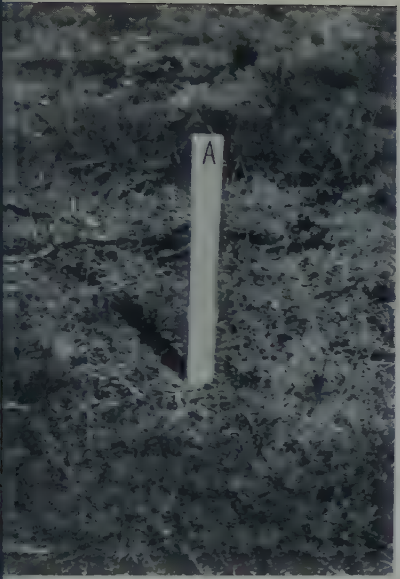
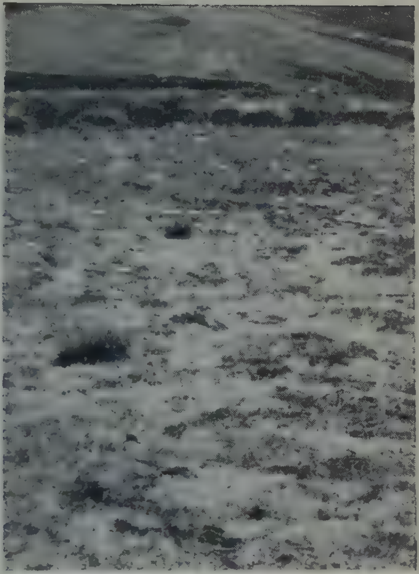
*Corrective manurial treatment per acre consisted of 3 tons Ground Limestone (98% $Ca.CO_3$) and 10 cwt. Basic Slag (18% sol. P_2O_5). Subsequent applications were 3 cwt. compound fertiliser (7½% N, 9% P_2O_5, 12% K_2O) and 2 cwt. "Nitro-chalk" in Spring 1953 and 1¼ cwt. "Nitro-chalk" in 1954.

†S.37, etc. = Aberystwyth strains.

**Before sowing the grass seed mixture the following manurial applications were given per acre: 4½ tons Ground Limestone (80% $Ca.CO_3$), 10 cwt. Basic Slag (15% sol. P_2O_5) and 2 cwt. Muriate of Potash (60% K_2O).

PLATE I.





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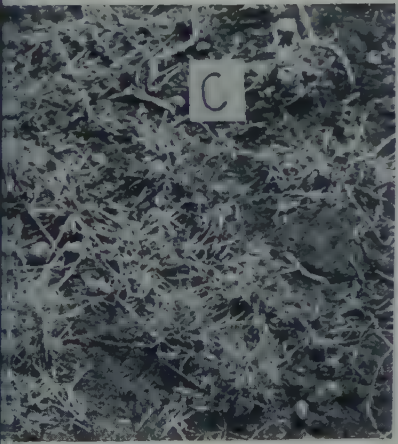

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1. Patch of dead herbage resulting from *Fusarium* attack on plot of South German Creeping Bent.
2. Complete "kill" of *Lolium perenne*.
3. Extensive *Fusarium* damage on sward of *Poa trivialis*.
4. Plot of *Alopecurus pratensis* (right) unaffected, with adjacent plot of *Agrostis* showing diseased patches.

2 cwt. "Nitro-chalk" were applied, followed by a further dressing of 2½ cwt. in September.

A good establishment was obtained and in February 1955 there was no sign of dying-out and growth was good. In April, however, dying-out was reported by T. Stockdale, Assistant Experimental Officer at Glensaugh. It was found that *Lolium perenne* (S.23) and *Agrostis tenuis* (N.Z. Bent) were infected, while *Dactylis* (S.143 and S.37) and *F. rubra* (S.59) were again unaffected. In the following year, there was little indication of damage and no sign of further infection.

Site 3. In March and April 1955 *Lolium perenne* in a temporary ley was extensively attacked. The soil was deep drift with somewhat impeded drainage at an elevation of 550 ft. The ley was sown out in spring 1954 without a cover crop and during summer and autumn was grazed. Winter grazing was by sheep only. Apart from an initial fertiliser dressing at the time of sowing, the area received no artificial manures prior to the *Fusarium* attack.* The seeds mixture used was a Cockle Park type and contained 12 lb. of *Lolium perenne* made up of two strains, namely, N.Z. Mother and Devon Eaver.

Although *Fusarium* damage was widely distributed throughout the field, with the onset of spring growth recovery was rapid and there was subsequently little evidence of permanent damage.

MISCELLANEOUS OBSERVATIONS.

Observations have been made, from time to time, to determine the extent to which *Fusarium nivale* is distributed in cultivated and semi-natural grasslands.

At Glensaugh, dying-out has occurred extensively on the *Agrostis-Festuca* which dominates the lower hill slopes up to about 700 ft. Incidence of the disease was widespread in the spring of 1956 when snow cover was prolonged and the fungus was identified in hollows and on slopes where the snow had lain longest. Species affected were *A. tenuis, A. canina* and *Poa annua,* damage to the last being evident especially along sheep tracks and hill roads. No sign of the disease was found on

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*Initial fertiliser dressing of 3 cwt./acre compound (8% N, 7½% P_2O_5 and 10% K_2O) and 1 cwt./acre "Nitro-chalk".

Deschampsia flexuosa, F. rubra and *Poa pratensis.* There was some evidence that *F. ovina* had been attacked, but this could not be confirmed.

Although observations have been made principally in Kincardineshire, evidence of recent infection was found in unenclosed *Agrostis-Festuca* pastures in the counties of Inverness, Perth and Argyll. No other cases of infection on temporary grassland have been observed.

PREDISPOSING CAUSES.

Intensive treatment of turf with fertiliser rich in soluble nitrogen, especially in late summer and early autumn, favours the disease (Dawson, 1938). None of the sites where the disease was recorded at Glensaugh, however, received intensive manurial treatment, although at Site 2, the September application of 2½ cwt. per acre of "Nitro-chalk" may have contributed to the attack. The disease was most severe and widespread in 1955 and 1956 and Table I shows that in the preceding autumn months of both years (especially autumn 1954) total rainfall was heavy, and the number of days on which rain fell was considerably greater in 1954 than in other years.

TABLE I.

Total Rainfall at Glensaugh and Number of Days when 0·04 or more inches of rain fell in Autumn months 1951-1955.

Year	SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
	a	b	a	b	a	b	a	b
1951	1·92	8	1·36	6	7·34	16	2·59	10
1952	1·15	8	3·80	15	3·40	13	4·60	17
1953	3·01	10	1·75	10	2·88	13	4·31	17
1954	2·43	14	6·41	18	7·65	17	3·91	15
1955	2·49	12	3·74	13	2·90	11	6·80	17

a — Total rainfall.
b — Number of days 0·04 or more inches.

At Glensaugh, the main predisposing causes seem to have been heavy autumn rainfall combined with prolonged snow cover in late winter and early spring.

RECOLONISATION OF AFFECTED AREAS.

In certain areas *Fusarium nivale* may be a more important factor than has been previously recognised in determining the development of semi-natural *Agrostis-Festuca* grassland. Where the attack is heavy, few individuals of the susceptible species survive over an area of up to several square feet. *Aira praecox,* which appears to be unaffected, colonises bare areas rapidly and often dominates local patches in May, June and July. Other components of the original community also spread vigorously after attack and apart from the resistant grasses and dicotyledonous plants, the mosses are of particular interest. *Polytrichum juniperinum, Dicranum scoparium* and *Hypnum cupressiforme* grow well on such areas and old centres of infection are often marked by an abundance of these species. After *Fusarium* attack on re-seeded humus soils at Glensaugh, *Ceratodon purpureus* and, to a lesser extent, *Funaria hygrometrica* play an important rôle in recolonisation. In one case an almost pure community of *Ceratodon* has developed.

ECONOMIC IMPORTANCE.

It seems surprising that the disease has not been reported more often on pasture grass in this country. The relative vigour of grass growth on cultivated pasture may account for its limited occurrence. It may be often overlooked, however, and more widely distributed than hitherto suspected, as damage to cultivated pasture does not appear to be permanent. The suggestion by Dawson (1938) that the worst attacks are associated with weakening of the tissue by intensive management is confirmed by observation in relation to lawns, bowling greens and other sports turf in the North of Scotland. On the other hand, the present observations on grassland of agricultural importance provide no evidence that intensive treatment is associated with incidence of the disease. Indeed the worst and most widespread attacks have been found on semi-natural *Agrostis-Festuca* grassland receiving no treatment with artificial fertilisers.

REFERENCES.

BENNETT, F. T. (1933). *Fusarium* Species on British Cereals, *Fusarium nivale* (Fr.) Ces. = ? *Calonectria graminicola* (Berk. & Br.) Wr. *Ann. Appl. Biol.*, **20**, 272-290.

DAWSON, R. B. (1938). *Practical Lawn Craft.* London.

EKSTRAND, H. (1947 a). Några växtpatologiska synpunkter på övervintringen av höstsäd och vallgräs med särskild hänsyn till försöksverksamheten inom jordbruket. *Medd. Växtskyddsanst., Stockh.*, 49.

EKSTRAND, H. (1947 b). Höstsäden och vinterhärdighetsproblemet med särskild hänsyn till resistensen mot vissa svampsjuksdomar. *Medd. Växtskyddsanst., Stockh.*, 50.

EKSTRAND, H. (1955). Övervintringen av höstsädda grödar och vallar vintern 1953-54. *Växtskyddsnotiser, Stockh.* **3**, 50.

JAMALAINEN, E. A. (1951). Förekomsten av övervintringssvampar på vallgräsen i Finland. *Nord. Jordbruksforsk.*, **2**, 529.

JAMALAINEN, E. A. (1954). Overwintering of cultivated plants under snow. *F.A.O. Pl. Prot. Bull., II*, 102.

JAMALAINEN, E. A. (1955). *Fusarium* Species causing Plant Diseases in Finland. *Acta agral. fenn.*, **83**, 159.

NOBLE, M., and MONTGOMERIE, I. G. (1954). Seed-borne Oat Diseases. *Scottish Agriculture*, **34**, 51.

SAMPSON, K., and WESTERN, J. H. (1954). *Diseases of British Grasses and Herbage Legumes.* Cambridge.

SPRAGUE, R. (1950). *Diseases of Cereals and Grasses in North America.* New York.

NOTES ON THE SCOTTISH FLORA.

KOENIGIA ISLANDICA L.

During the summer of 1956 the Edinburgh University Biological Society visited Mull, and on July 16th *Koenigia islandica* L. was discovered by the author growing on the north end of Maol Mheadhonach on the Ardmeanach peninsula in the south-west of the island. This locality was relatively flat and very exposed on the summit at about 1,500 feet, with a substrate of bare gravelly soil. Many plants were observed in a limited area. *Koenigia* was not recognized at the time of collection and it is possible that the species occurs in other localities in Mull. The only other flowering plant seen associated with *Koenigia* was *Sagina subulata* (Sw.) C. Presl.

On the following day Miss A. Beckett and Miss F. Oldfield also found *Koenigia* in the same locality.

R. W. M. Corner.

SAXIFRAGA CERNUA, S. RIVULARIS AND S. CAESPITOSA ON THE BEN NEVIS RANGE.

On 5th and 6th August 1956, *Saxifraga cernua* L. was discovered growing above 3,000 ft. on two of the Ben Nevis range of mountains. In both places it was growing on limestone rock with a direct northerly exposure. Other calcicolous species were found at both localities but the very limited outcrop of lime-rich rocks was surrounded by others with a poor base status.

In the locality discovered on 5th August a small number of plants of *S. cernua,* producing their characteristic bulbils, occurred on rock ledges with many plants of *S. caespitosa* L. and a few of *S. rivularis* L., both in full flower, probably the only known occurrence in Scotland of the three species growing together. *S. rivularis* was fairly common on wet moss-covered scree and sloping rock immediately below the colony of *S. cernua*. Closely associated species included: *Blechnum spicant* (rare), *Cerastium edmondstonii* (occasional), *C. cerastioides* (frequent), *Cochlearia alpina* (frequent), *Epilobium alsinifolium* (rare), *Poa alpina* (frequent), *Ranunculus acris* (occasional), *Saxifraga stellaris* (rare), *Sedum roseum* (occasional), *Silene acaulis* (rare), *Taraxacum* sp. (rare), *Veronica alpina* (one small colony), *V. humifusa* (very frequent and possibly the largest colony so far discovered in

Scotland). Growing immediately above this association were *Gnaphalium supinum, Salix herbacea* and *Sibbaldia procumbens.*

At the second locality the colony of *S. cernua* consisted of approximately 90-100 plants, of which about 55 were producing bulbils (a contrast to the depleted population on Ben Lawers). The plants were confined to an area of two vertical square yards of rock face and grew rooted amongst small mosses and liverworts. No other flowering plants occurred on the rock but closely adjacent were *Armeria maritima* and *Saxifraga oppositifolia.* Immediately below, on flushed sloping soil, grew *Cerastium edmondstonii, C. cerastioides, C. vulgatum, Cochlearia alpina, Chrysosplenium oppositifolium, Deschampsia alpina, Oxyria digyna, Poa alpina, Ranunculus acris, Saxifraga hypnoides, S. stellaris, Veronica alpina* and *V. humifusa.*

E. A. BLAKE.

PLANT DISTRIBUTION AND COMMUNITIES ON FOINNE BHEINN (SUTHERLAND).

A visit to this noted mountain about 14 miles south-east of Cape Wrath revealed a remarkably varied and complex flora as compared with that of the other mountains of north-west Scotland—mountains noted for an exceptionally poor flora. Foinne Bheinn consists of Cambrian quartzite lying unconformably on a bed of Lewisian gneiss.

The most remarkable of the plants found on Foinne Bheinn was *Cherleria sedoides,* a plant usually associated in Scotland with basic rocks. This species was widespread on both the Lewisian gneiss (an acidic type of rock) and the Cambrian quartzite (an acidic rock which is almost 100% silica compared with 55-65% in granites). *Cherleria sedoides* must now therefore be included among plants which on highly exposed ridges and upper slopes grow irrespective of the nature of the underlying rock but which normally require base-rich immature soils.

Cherleria sedoides was found from approximately 2,500 ft. upwards to at least 2,900 ft. (the summit is at 2,980 ft.) growing in a carpet of *Rhacomitrium lanuginosum,* often accompanying and closely associated with *Armeria maritima* and *Silene acaulis* (both as frequent and as widespread). A sample community at 2,500 ft. on a steep slope with a due westerly exposure consisted of a mosaic of *Cherleria sedoides, Silene acaulis, Armeria maritima,* and *Thymus drucei* with, in scattered occurrences, *Agrostis tenuis, Festuca vivipara, Vaccinium myrtillus* and the mosses *Rhacomitrium lanuginosum* and *Polytrichum* sp. This pattern varied in many places by the exclusion, more often than not, of either *Silene acaulis* or *Cherleria sedoides, Armeria maritima* being the most uniformly distributed. Despite the nature of the rock and the steepness of the slope, a closed community was prevalent up to the apex of the ridge, except for scattered boulders.

In this respect it is worth noting that the upper slopes of quartzite on westerly facing slopes are bare scree with only isolated cushion plants. Apart from the northern extremity of the ridge, the mountain is quartzite-capped and the flanks are uniformly draped with a scree of this rock.

The summit supports a carpet of *Rhacomitrium lanuginosum,* torn and lifted in the places of greatest exposure. Associated species established with *Rhacomitrium* at this elevation included: *Agrostis canina* (evenly but thinly distributed), *Festuca vivipara, Carex bigelowii, Armeria maritima, Lycopodium selago* (a few plants) and *Juncus trifidus* (occasional). Adjacent to the flat summit ridge but growing on the slope with a northerly exposure, and included with similar species as above, were occasional plants of *Deschampsia flexuosa,* whilst *Cherleria sedoides* was rarer.

The more or less open community growing on quartzite detritus on the col at 2,700 ft., with extreme exposure, consisted of *Rhacomitrium lanuginosum* together with *Cherleria sedoides, Silene acaulis, Armeria maritima, Cardaminopsis petraea, Salix herbacea, Festuca vivipara* and *Juncus trifidus.*

Cliffs of gneiss with an easterly exposure above the corrie supported *Deschampsia caespitosa* on the ledges, and *D. caespitosa* also grew on flushed grassland above the cliffs and in sheltered hollows in the lea of boulders on the north summit.

Confined to an elevation of 1,750 ft. and limited to an almost flat ridge with a westerly exposure and much bare Lewisian gneiss was a community containing *Arctous alpina.* The *Arctous* spread mostly through stunted *Calluna vulgaris,* but growing in association were *Rhacomitrium lanuginosum,* a spreading carpet of *Empetrum hermaphroditum, Erica cinerea, Salix herbacea, Agrostis* spp., *Festuca vivipara, Nardus stricta, Trichophorum caespitosum, Antennaria dioica, Succisa pratensis, Lycopodium selago* and *Carex vaginata.*

E. A. Blake.

NEW VICE-COUNTY RECORD.

SALIX RETICULATA L. IN W. SUTHERLAND (V.-C. 108).

This species is known on certain crags between 1,400 ft. and 1,700 ft. on Ben Hope. It occurs on steep, unstable slopes overlying calcareous hornblende-schists, in a rich community with such species as *Cherleria sedoides* L., *Potentilla crantzii* (Crantz) Beck, *Asplenium viride* Huds., *Carex capillaris* L. and *Dryas octopetala* L.; however, it is extremely scarce. The area in which it occurs is subject to rather frequent landslides and thus the quantity of the willow varies from year to year.

R. E. C. FERREIRA.

DRYAS OCTOPETALA L. IN BANFFSHIRE (V.-C. 94).

This species occurs very locally on the Eastern Cairngorms within Banffshire on moist granitic rocks at elevations between 3,000 and 3,200 ft., and has here probably its highest altitudinal range in the British Isles. On 4th August, 1956, the *Dryas* was found in this area associated with *Carex atrata* L. and *Potentilla crantzii* (Crantz) Beck. (*Saxifraga nivalis* L. also occurs in this remote region of Banffshire, on granite at about 3,050 ft.)

J. GRANT ROGER.

CAREX BUXBAUMII WAHLENB. IN EAST INVERNESS-SHIRE (V.-C. 97).

This sedge has been known since 1895 near Arisaig in West Inverness-shire (*J. Bot.*, 1895, **33**, 282), but its presence in East Inverness-shire is probably unknown except to very few botanists. In this latter vice-county it was first found on 29th July, 1954, by Dr. D. S. Kettle on marshy moorland at an elevation of about 800 ft. within the Parish of Urquhart and Glenmoriston. Here the plants growing near the sedge on 9th July, 1956, included *Carex panicea* L., *C. pulicaris* L., *C. rostrata* Stokes, *Drosera anglica* Huds., *Galium palustre* L., *Myrica gale* L., *Ranunculus flammula* L., with the mosses *Acrocladium cuspidatum* (Hedw.) Lindb. and *Campylium stellatum* (Hedw.) Lang & C. Jens. In very boggy places several yards away were *Carex lasiocarpa* Ehrh. and *C. limosa* L.

Carex buxbaumii, being one of the very rarest of British flowering plants, merits careful protection in its two known Scottish habitats.

J. GRANT ROGER.

DIAPENSIA LAPPONICA L. IN SCOTLAND.

In the paper on this subject published in *Trans. Bot. Soc. Edinb.,* 1952, **36**, 34, it is mentioned that the flowers of *Diapensia lapponica* appear in June and July. This statement has been found to be inaccurate and misleading in the light of fuller knowledge, and experience in the field has shown that the flowers appear usually between mid-May and mid-June.

J. GRANT ROGER.

SAXIFRAGA HYPNOIDES L. ON THE COAST OF BANFFSHIRE.

Saxifraga hypnoides is found very locally on the North-East coast of Scotland and although its presence on a seaward slope in the parish of Gamrie, Banffshire, has been known for over a hundred years (see *New Statistical Account of Scotland*, Vol. XIII, 1845, p. 280) little attention seems to have been paid to the ecological aspects of its occurrence in this area, from which, however, there are excellent specimens of the species in the herbarium of the Botany Department, Aberdeen University. The following notes were prepared from field observations made in 1955 and 1956.

Position of Habitat. The saxifrage grows at about 50 ft. towards the base of a coastal cliff on small areas of scree and also on an adjacent dune where the slope is 15° and the aspect northerly. It may be noted that the species only very rarely occurs on dunes in Britain (Webb, 1950). The total height of the cliff is about 375 ft., the upper parts being very steep but the lower slopes (mainly *Festuca* grassland) falling more gradually to the sea shore.

Geology and Soil. The scree is formed from rock belonging to the Macduff group of slates of the Dalradian Series (Read, 1948), and is a fairly hard grey slate, only moderately cleaved, and containing, notably, veins of calcite. The dune is calcareous, containing a considerable amount of broken shell.

Soil Profiles.

SCREE HABITAT.	DUNE HABITAT.
1. Layer of black humus, under 1 in.	1. Bryophytes to 1 in.
2. Stones to a depth of at least 1 ft.	2. Litter, 1 in. to 3 in.
No sand present.	3. Humus-rich sand, 3 in. to 5 in. with shells.
	4. Sand with some humus, 5 in. to 2 ft. or more, and a few stones of the scree.

pH Readings.

A Pye pH meter was used in the field and the following readings were obtained:

SCREE HABITAT.	DUNE HABITAT.
1. Soil immediately above scree inhabited by *Saxifraga hypnoides* pH range 6·0 to 6·1.	1. Litter, pH range 6·2 (read in laboratory).
	2. Humus-rich sands, at 4 in., pH range 6·7 to 7·0.
	3. Sand at 8 in., pH range 6·9 to 7·2.
	4. Sand at 2 ft., pH range 6·8 to 7·0.

Growth-Habits.

SCREE HABITAT.	DUNE HABITAT.
1. Rooting mainly in the thin layer of black humus and not penetrating the scree to any extent.	1. Rooting mainly in humus-rich sand.
2. Close cushions of small rosettes and no procumbent sterile shoots; forming well developed cushions up to 2 ft. 6 in. across and 4 in. high.	2. Loose rosettes and occasional procumbent sterile shoots forming indefinite patches of large size, mixed with bryophytes.
3. Cover scanty, to 100% at margins but only a few per cent in centre of scree patches: most plants colonizing inwards from the margin of the unstable scree.	3. Cover 100% throughout.

*Associated Species.**

(d.=dominant; a.=abundant: f.=frequent; o.=occasional; l.=local; r.=rare)

SCREE HABITAT.	
BELLIS PERENNIS	o.
FESTUCA OVINA	f.
GERANIUM ROBERTIANUM	o.
HOLCUS LANATUS	f.
HYPERICUM PULCHRUM	o.
HYPOCHAERIS RADICATA	o.
PTERIDIUM AQUILINUM	r.
RANUNCULUS ACRIS	o.
RUMEX ACETOSA	o.
SOLIDAGO VIRGAUREA	o.
SUCCISA PRATENSIS	o.
DICRANUM SCOPARIUM	o.
FRULLANIA TAMARISCI	f.
HYPNUM CUPRESSIFORME	f.
LOPHOZIA ATLANTICA	r.
PLEUROZIUM SCHREBERI	f.
PSEUDOSCLEROPODIUM PURUM	f.
RHYTIDIADELPHUS SQUARROSUS	f.
R. TRIQUETRUS	f.
CLADONIA PYXIDATA	o.
PELTIGERA CANINA	f.

DUNE HABITAT.	
ACHILLEA MILLEFOLIUM	r.
AMMOPHILA ARENARIA	a.
ANGELICA SYLVESTRIS	o.
CENTAUREA NIGRA	l.
DACTYLIS GLOMERATA	o.
FESTUCA OVINA	d.
HIERACIUM SP.	o.
HOLCUS LANATUS	a.
MELANDRIUM RUBRUM	l.
PRIMULA VULGARIS	f.
PTERIDIUM AQUILINUM	o.
SOLIDAGO VIRGAUREA	o.
SUCCISA PRATENSIS	o.
CEPHALOZIELLA SP.	o.
EURHYNCHIUM PRAELONGUM	f.
HYPNUM CUPRESSIFORME	f.
HYLOCOMIUM SPLENDENS	a.
LOPHOCOLEA BIDENTATA	f.
MNIUM LONGIROSTRUM	r.
PSEUDOSCLEROPODIUM PURUM	f.
RHYTIDIADELPHUS SQUARROSUS	a.
THUIDIUM TAMARISCINUM	l.
PELTIGERA CANINA	f.

In both the scree and dune habitats the saxifrage is very closely associated with mosses, particularly *Hylocomium splendens* in the case of the dune area.

REFERENCES.

CLAPHAM, A. R., TUTIN, T. G., and WARBURG, E. F. (1952). *Flora of the British Isles.* Cambridge.

CRAIB, W. G. (1912). *The Flora of Banffshire.* Banffshire Field Club.

DICKIE, G. (1860). *The Botanists Guide to the Counties of Aberdeen, Banff and Kincardine.* Aberdeen.

MAHOOD, A. E. (1919). *Banff and District.* Banff.

READ, H. H. (1948). *The Grampian Highlands.* 2nd ed. revised by A. G. MacGregor. H.M. Stationery Office, Edinburgh.

READ, H. H. (1955). The Banff nappe: an interpretation of the structure of the Dalradian rocks of North-East Scotland. *Proc. Geol. Assoc.*, **66**, 1-28.

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*The nomenclature for vascular plants follows Clapham, Tutin & Warburg (1952); for mosses, Richards and Wallace (1950); for hepatics, Wilson (1930); and for lichens, Watson (1953).

Richards, P. W., and Wallace, E. C. (1950). An annotated List of British Mosses. *Appendix to Trans. Brit. Bryol. Soc.*, **1**.

Trail, J. W. H. (1902). The Flora of Buchan, reprinted from *Trans. Buchan Field Club*, Vol. VI.

Watson, W. (1953). Census Catalogue of British Lichens. *British Mycological Society.*

Webb, D. A. (1950). Biological Flora of the British Isles. *Saxifraga* L. (Section Dactyloides Tausch). *J. Ecol.*, **38**, 185.

Wilson, A. (1930). *A Census Catalogue of British Hepatics*, 3rd ed. Berwick-on-Tweed.

R. E. C. Ferreira and J. Grant Roger.

REPORT OF THE CRYPTOGAMIC SECTION, 1956.

BY D. M. HENDERSON.

The sixty-eighth annual Autumn Foray was held in Peebles and district on the 29th and 30th of September. On the first day collections were made from the Forestry Commission's forest at Glentress but the material collected was very disappointing, even when allowance is made for the fact that the area is not natural woodland. In the headquarters in the Waverley Hotel a room with all facilities was available for examination of specimens and the evening was spent on this task. Dawyck Estate was visited on the second day in very wet conditions, and, although a few fungi were collected, most of the larger fungi seen were poor specimens of common species. Nine members attended each foray. The accompanying list of species collected demonstrates the paucity of interesting fungi on ground which on previous forays has yielded many notable collections.

LIST OF FUNGI COLLECTED.

(a, Glentress Forest b, Dawyck Estate.)

AMANITA RUBESCENS, b.
ARMILLARIA MELLEA, a, b; MUCIDA, b.
TRICHOLOMA ALBUM, b; RUTILANS, a; CARNEUM, a,
CLITOCYBE FLACCIDA, a; DITOPUS, a, b.
LACCARIA LACCATA, b.
MYCENA PURA, a; EPIPTERYGIA, a; PELLICULOSA, a; AMMONIACA, a.
COLLYBIA RANCIDA, a.
MARASMIUS CONFLUENS, b; DRYOPHILUS, b; ESCULENTUS, b; ANDROSACEUS, b.
PLEUROTUS MITIS, a.
HYGROPHORUS PUSTULATUS, a.
LACTARIUS TURPIS, b; BLENNIUS, b.
RUSSULA CYANOXANTHA, b; OCHROLEUCA, b; DRIMEIA, b.
CANTHARELLUS CIBARIUS, b.
NOLANEA STAUROSPORA, b; CETRATA, b.
FLAMMULA ALNICOLA, b.

Cortinarius crocolitus, b; cinnamomeus, a.
Inocybe pudica, a; geophylla, a.
Hypholoma fasciculare, b; sublateritium, a; dispersum, a.
Psathyrella subatrata, a.
Polyporus betulinus, b; mollis, a; caesius, b; stipticus, a.
Fomes annosus, a.

COMMITTEE FOR THE STUDY OF THE SCOTTISH FLORA.

Second Annual Report to 31st December 1956.

During the first full year of its existence the Committee arranged two Exhibition Meetings, one in the spring and one in the autumn, and a number of field meetings (chiefly to help the Distribution Maps Scheme) during the summer.

The Field Meetings were held at Dalmellington (26th-27th May), led by Mr. R. Mackechnie and attended by 2 others; Peebles (15th-17th June), led by Mr. P. S. Green and attended by 8 others; Cromarty (30th June-7th July), led by Miss U. K. Duncan who deputised for Mr. Burtt, and attended by 6 others; and Hawick (7th-9th September), led by Mr. J. Grant Roger and attended by 7 others. A one-day Junior Meeting, led by Mr. Ribbons, attended by about 60, was held at Ben Ledi, Perthshire, on Saturday, 16th June. Reports of these meetings will appear in the *Proceedings* of the B.S.B.I. (Vol. **2**, pt. 3).

The Spring Exhibition Meeting took place in the Royal Academy, Inverness (by kind permission of the Director of Education and the Rector), on Friday, 9th March 1956, and about 130 people were present. The visitors were welcomed by the Rector, Mr. D. J. Macdonald and later in the evening Mr. Roger showed colour transparencies of high altitude Scottish plants. Among the exhibits were the following: Sheets of *Batrachium* spp. (Miss U. K. Duncan); sheets of rare plants from Inverness-shire from the Royal Botanic Garden, Edinburgh; the two Water-cresses, *Nasturtium officinale* and *N. microphyllum* and their hybrid (P. S. Green); plants from Switzerland having Scottish associations (R. Mackechnie); photographs and charts demonstrating the morphological responses to grazing in *Erica cinerea* and *Calluna vulgaris* (C. H. Gimingham); map of hydrosere at Loch of Park near Banchory, Aberdeenshire (C. H. Gimingham and E. T. Robertson); British Dandelions (A. J. C. Grierson); British species of *Pinguicula*, original plates drawn by Miss Stella Ross-Craig for her series *Drawings of British Plants* (B. L. Burtt); grasses, sedges and rushes, mostly from Morayshire and including the cross *Festuca rubra* × *Vulpia membranacea* from Southport (M. McCallum Webster); and an exhibit provided by Mrs. Poore on the Distribution Maps Scheme. Grateful thanks are due to Mrs. Caldwell and Mr. Wright who made most of the local arrangements. Two useful results of the meeting were that local people agreed to help in recording for the Maps Scheme and that a series of evening classes in Botany began in Inverness.

The Autumn Exhibition Meeting was held in the Department of Botany of the University of Glasgow (by kind permission of the Regius Professor of Botany and of the University Court) on Saturday, 10th November 1956, when about 80 people were present. The following exhibits were shown: Specimens of *Saxifraga cernua, S. rivularis,* and *S. cespitosa* from the Herbarium were displayed to illustrate the finding in 1956 of these three species growing together on limestone rock above 3,000 feet in the Ben Nevis range. *S. cernua* had been seen on two mountains and on one of them 90-100 plants were counted, 55 producing bulbils (E. A. Blake); plants from Switzerland having Scottish associations (R. Mackechnie); *Alchemilla vulgaris* in Britain (Miss M. E. Bradshaw); 14 of the 35 new county records made at the Cromarty field meeting (Miss U. K. Duncan); *Aremonia agrimonioides* in Scotland (D. McClintock and P. S. Green); the genus *Galinsoga* in Scotland (P. S. Green); *Hierochloë odorata* specimens from three Scottish localities (Glasgow University Herbarium) together with colour transparencies of the species in its Renfrewshire station (B. W. Ribbons); plants from the Kincardineshire coast (Miss I. K. Munro and Miss A. R. Hutchison); Alpine species from north-west Scotland (J. H. Dickson); Scottish seaweeds to show the subspecies of *Fucus inflatus* and the dichotomous species of *Codium* (Dr. E. Conway). New records from Scotland received at the Royal Botanic Garden during 1956: *Koenigia islandica* in Mull at the north end of Maol Mheadhonach on the Ardmeanoch Peninsula, and *Melampyrum arvense* from Melrose (R. W. M. Corner), *Spartina townsendii* from Kirkcudbrightshire (J. B. Primrose), and *Carex buxbaumii* from East Inverness-shire (J. G. Roger); the progress in the Distribution Maps Scheme in Scotland (Miss E. P. Beattie).

After tea Miss Beattie, the Scottish Regional Officer, spoke about the Maps Scheme and then Mr. Ribbons showed colour transparencies of *Phyllodoce coerulea* and of plants of the Scottish coast which were commented upon by himself and Mr. Mackechnie.

The Chairman of the Committee, Mr. Burtt, presided at both the Spring and Autumn Exhibition Meetings.

The membership of the committee remained unchanged until October when the Botanical Society of Edinburgh appointed Mr. D. M. Henderson to replace Mr. Burtt as representative of its Council.

The Committee is very grateful for all the assistance given by members and friends and also to the officers of the two sponsoring societies for their continued helpful co-operation

B. W. Ribbons.

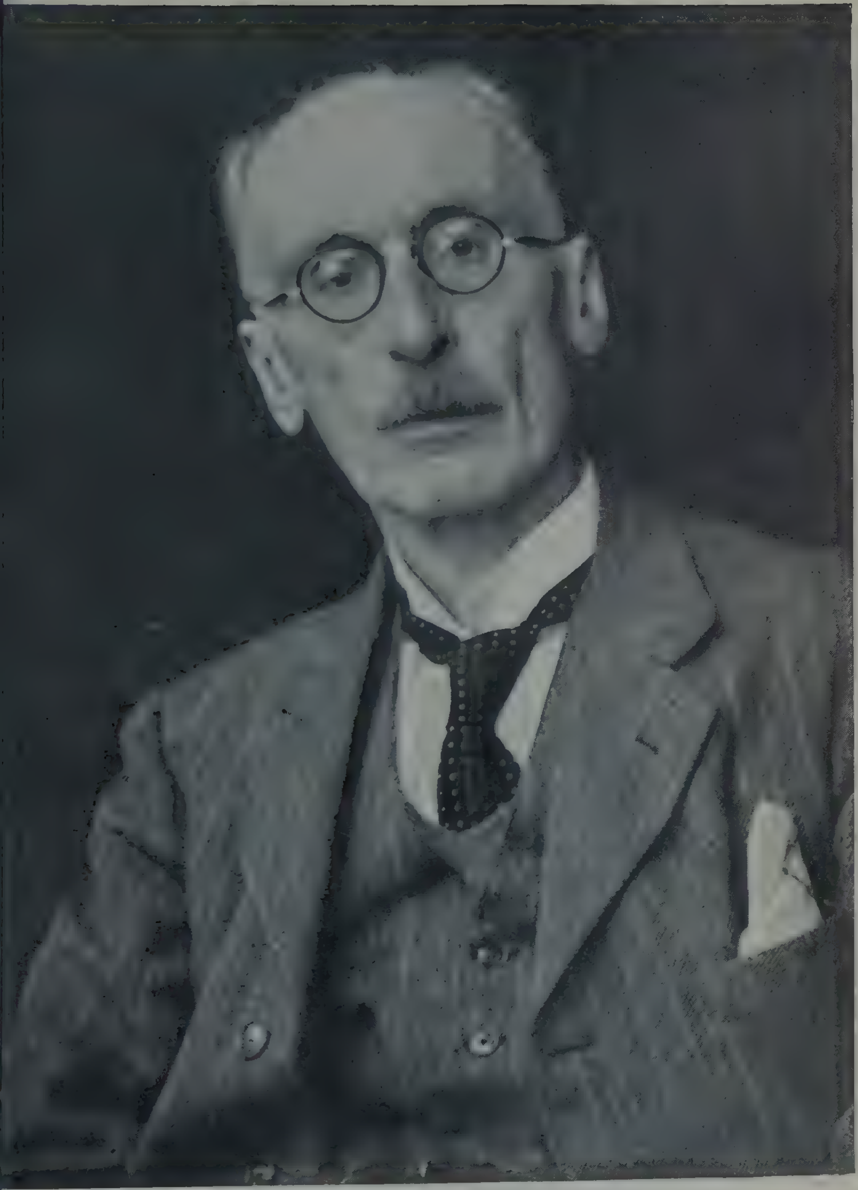
SIR WILLIAM WRIGHT SMITH, F.R.S., D. ès Sc., LL.D., F.L.S., F.R.S.E.

By upbringing and by inclination Sir William Wright Smith was essentially a countryman, and his attachment to wide open spaces remained throughout a long and active life. He had an intense dislike of crowds. Born at Lochmaben on February 2, 1875, he received his early education at Dumfries Academy and at sixteen years of age entered the University of Edinburgh as First Bursar. Whilst pursuing the Arts curriculum at the University he attended the Diploma course at Moray House Training College and was a qualified teacher when he graduated in 1896.

A teaching appointment in Edinburgh provided him with the opportunity to continue scientific studies, particularly Botany, Chemistry and Zoology, and in 1902 at the invitation of Sir Isaac Bayley Balfour he accepted a lectureship in the Botany Department of the University of Edinburgh. Thus began a remarkable botanical career which lasted more than half a century.

At the beginning of the century the academic staff of the Botany Department was small, and in his teaching Smith had to cover a wide field. As in the case of others who have had a similar experience it was no disadvantage, and the time spent in the Edinburgh School of Botany provided an all-round training for what was to follow. In 1907 he went to India and remained there for four years. It was a period of much activity and of varied and fruitful experience, as Curator of the Government Herbarium at the Royal Botanic Gardens, Calcutta, and as acting Superintendent of the Gardens. Such activities gave first-hand acquaintance with Government administration, and they were extended to the care and direction of the Lloyd Botanic Garden at Darjeeling, the Sikkim cinchona plantations and the quinine factory at Mungpoo. In this way Smith gained a knowledge of some of the economic problems of India—not all of them botanical.

Although Hooker's *Flora of British India* had been completed before the end of last century, much territory remained to be explored, and as Acting Director of the Botanical Survey of



Sir William Wright Smith

India, Smith undertook a number of expeditions into little-known regions of the Himalaya, especially in Sikkim and the borders of Nepal, Tibet and Bhutan. Of special interest was his exploration of the practically unknown area of Llonakh on the Tibetan frontier, north of the Kangchenjunga glaciers, where in 1909 he spent a considerable time working the flora of hitherto untraversed alpine regions at altitudes of over 14,000 feet. A further exploration followed in 1910 when he penetrated into the high region between the Tibetan valley of Chumbi and Eastern Sikkim. To botanise in such high places demands considerable powers of endurance and more than ordinary skill in climbing; on his return to this country and for long afterwards, nothing gave more satisfaction to the leader of these Himalayan expeditions than a long moorland walk or a climb to the top of a Scottish mountain.

The expeditions in India produced a wealth of material for systematic study, the results of which were published in a series of papers in the *Records of the Botanical Survey of India.* But they did more; they led to an intimate knowledge of the country and of the people of some of its remoter parts—knowledge which was to bear fruit in later years.

The year 1911 saw Smith back in Edinburgh as Deputy Keeper of the Botanic Garden, in the development of which there had been impressive and far-reaching changes under the driving force of Bayley Balfour. In 1904 George Forrest had embarked on the first of his seven expeditions to Western China and for many years the stream of new collections from this and neighbouring regions continued to pour into Edinburgh for systematic analysis. Balfour concentrated mainly on *Primula* and *Rhododendron* and it fell to Smith to deal with much of the remaining store of material. During the years 1912-21 there appeared from his pen in *Notes Roy. Bot. Gdn. Edin.* the descriptions of some 550 species new to science, while at the same time he contributed numerous important papers to the *Transactions* of our own Society, among which may be mentioned specially his account of Chinese Lilies.

In 1922, following the retirement of Balfour, Smith succeeded to the dual post of Regius Keeper of the Botanic Garden and Professor of Botany in the University of Edinburgh. It was signal recognition of his worth and fitness to occupy a unique position as Chief of a large University Department and Director of one of the great Botanic Gardens of the world. The appointment caused no break in the work of elucidating the flora of China, though the emphasis changed. Smith now directed his attention to a few selected genera, particularly *Rhododendron* and *Primula,* and jointly with Forrest he presented a revision of the sections of the genus *Primula* to the Primula Conference held by the Royal Horticultural Society in 1928. This was the foundation for a much more exhaustive examination of the genus, undertaken in conjunction with Dr. H. R. Fletcher, the results being published in a long series of papers in the *Transactions of the Royal Society of Edinburgh* and in the *Transactions of the Botanical Society.*

Smith's taxonomic work added greatly to our knowledge of the flora of Asia, but it had another significance in that much of it was related to the development of the Botanic Garden and the enrichment of its collection of growing plants. As a centre for the propagation and cultivation of plants, especially those from the Far East, the Edinburgh Garden became deservedly famous. Smith was adept at keeping in touch with many of the students he had trained, large numbers of whom found responsible posts in different parts of the world, and if he required a particular plant even from the ends of the earth, he usually knew the means of securing it.

It was natural that his contributions to botany and horticulture should be widely recognised. He was knighted in 1932. For many years he was an Honorary President of the Royal Caledonian Horticultural Society, a Vice-President of the Royal Horticultural Society and its Honorary Professor of Botany. In 1925 he was awarded the Victoria Medal of Honour and in 1930 the Veitch Memorial Medal. He was an Honorary Member of the American Academy of Arts and Sciences, D. ès Sc. of the University of Toulouse and LL.D. of the University of Aberdeen. For his notable contributions to Systematic Botany he was awarded in 1942 the Makdougall-Brisbane Prize of the Royal Society of Edinburgh, of which he was President from 1944-49, and he was elected a Fellow of the Royal Society in 1945. His scientific advice was widely sought and he played an active part in numerous committees dealing with horticulture and forestry. Of particular value was his service for twenty-five years on the

Horticultural Advisory Committee of the Department of Agriculture for Scotland.

But to no scientific body was he more attached than to the Botanical Society of Edinburgh. At the time of his death he had been a Fellow for fifty-four years, having been elected in 1902. His first published paper—a note on *Arenaria tenuifolia*—appeared in the *Transactions* in 1905, and he was still contributing to their pages in 1950. For some years he was Honorary Secretary of the Society and subsequently acted as Foreign Secretary. He was three times President, the second occasion coinciding with the Centenary celebrations of the Society in 1936, when he welcomed many visitors from home and overseas. He will be long remembered as a familiar figure at the Society's meetings and for many an entertaining address. No member was more regular in attendance, but it was in a quiet and unobtrusive way that he did more than is generally known for its welfare, and the Society owes much to his sustained interest and unfailing support.

While Smith's writings were mainly in the realm of taxonomy, there were occasions when he touched upon other topics, as in the "Masters Lectures" delivered to the Royal Horticultural Society in 1935. He constantly insisted on the diversity of the plant world, and on evolutionary questions he held pronounced and sometimes somewhat unorthodox views. He would frequently quote Rudyard Kipling:

> " There are nine and sixty ways of constructing tribal lays,
> And-every-single-one-of-them-is-right."

Sir William died on December 15, 1956, and by his death many fellows and members of our Society have lost a good friend and a helpful colleague. He is survived by Lady Smith and three daughters.

J. R. MATTHEWS

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